Instruction Manual

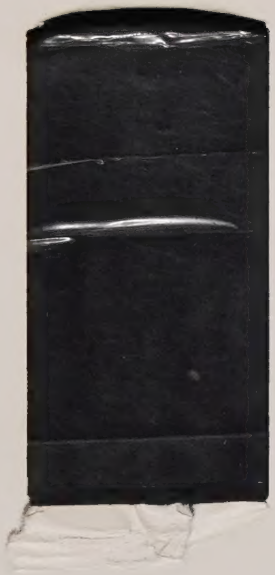
MODEL

1952B

UNIVERSAL COUNTER-TIMER

FLUKE®

JOHN FLUKE mfg. co., inc.
SEATTLE, WASHINGTON



JOHN FLUKE MFG. CO., INC.

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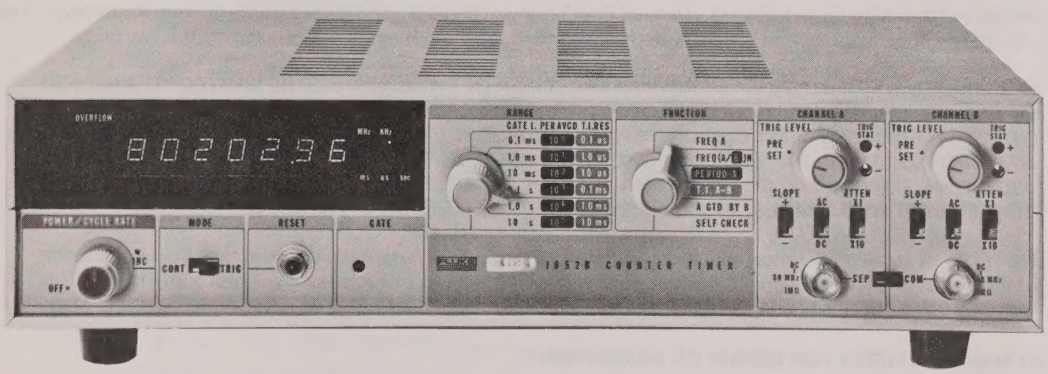

MODEL

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UNIVERSAL COUNTER-TIMER

P/N 390054
DECEMBER, 1975

LIMITED WARRANTY

The JOHN FLUKE MFG. CO., INC., warrants each instrument manufactured by it to be free from defects in material and workmanship. This obligation under this Warranty is limited to servicing or adjusting an instrument returned to the factory for that purpose, and to making good at the factory any part or parts thereof; except tubes, fuses, choppers and batteries, which instrument shall, within one year after delivery to the original purchaser, be returned by the original purchaser with transportation charges prepaid, and which upon Fluke examination shall disclose to its satisfaction to have been defective. If the fault has been caused by misuse or abnormal conditions of operations, repairs will be billed at a nominal cost. In this case, an estimate before work is started, will be furnished upon request.

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1. Notify the John Fluke Mfg. Co., Inc., giving full details of the difficulty, and include the Model number, type number, and serial number. On receipt of this information, service data or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate will be made before the work begins, provided the instrument is not covered by the Warranty.

ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS SHALL BE LIMITED TO A PERIOD OF TWELVE MONTHS FROM THE DATE OF PURCHASE. THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. JOHN FLUKE MFG. CO., INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT OR OTHERWISE.

NOTE: Some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental or consaequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of John Fluke Mfg. Co., Inc., instruments should be made via United Parcel or "Best Way" prepaid. *The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to John Fluke Mfg. Co., Inc. *Upon receipt of this report, you will be advised of the disposition of the equipment for repair or replacement. Include the model number, type number, and serial number when referring to this instrument for any reason.

The John Fluke Mfg. Co., Inc., *will be happy to answer all application or use questions which will enhance your use of this instrument. Please address your request to: JOHN FLUKE MFG. CO., INC., P.O. Box 43210, MOUNTLAKE TERRACE, WASHINGTON 98043**.

*For European customers, Air Freight prepaid.
**For European Customers: FLUKE (Nederland) B.V. Zevenheuvelenweg 53, Tilburg, Netherlands

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Section 1

Introduction & Specifications

1-1 INTRODUCTION

1-2 The Fluke Model 1952B is a universal, DC to 80 MHz, counter/timer capable of making frequency, frequency ratio, period, time interval, gateable totalize, and self check measurements. Each measurement mode and one of six associated ranges are individually selectable using the front panel FUNCTION and RANGE switches.

1-3 Front panel features include individual trigger level adjustments for the CHANNEL A and B input signals, switch selection of a continuous or single measurement cycle, and a seven digit display.

1-4 A self check mode provides a convenient method of verifying the overall operation of the 1952B. In this mode, the counter is configured such that a frequency measurement is made using the 100 kHz output of the internal frequency standard as an unknown input. A valid readout for each setting of the range switch verifies proper overall operation.

1-5 The trigger level controls allow the operator to manually define the conditions under which the individual CHANNEL A and B inputs will accept an input signal as a trigger. Switches are used to select x1 or x10 attenuation, ac or dc coupling, and + or - slope triggering. A continuously variable trigger level control is used to set the + or - dc threshold voltage which the input signal must exceed before being accepted as an input signal. A PRESET position on the trigger level adjustment sets the threshold to 0 V dc. Two light emitting diode (LED) Status Indicators operate in conjunction with the variable trigger level to simplify the task of establishing proper triggering.

1-6 A measurement can be continuously repeated at an adjustable rate, or a front panel manual RESET command can be selected to initiate each measurement cycle.

1-7 The front panel display on the standard instrument consists of a seven digit readout plus six range annunciators (measurement units indicators). The display is equipped with leading zero suppression for all decades except the least significant decade (LSD). Decimal point location, if any, is fixed according to the selected FUNCTION and RANGE, and is supplemented, when necessary,

by the illumination of one or more of the measurement units indicators.

1-8 A factory installed option (-03) is available which provides a temperature compensated crystal oscillator (TCXO) and an eight digit display for higher measurement accuracy and resolution.

1-9 The model 1952B is designed as a bench-top instrument. However, by installing the Accessory Rack Mounting Kit (part no. M00-200-614) the 1952B can be mounted in a standard 19 inch equipment rack. Input power requirements are 115 or 230 V ac ± 10%, 50 to 400 Hz, 20 Watts.

TABLE 1-1 - AVAILABLE OPTION

OPTION	DESCRIPTION	INSTALLATION	
		FACTORY	FIELD
-03	-03 TEMPERATURE COMPENSATED CRYSTAL OSCILLATOR (TCXO) AND 8 DIGIT DISPLAY	X	-

1-10 SPECIFICATIONS

Operating Modes

FREQUENCY

Range	DC to 80 MHz (dc coupled) 5 Hz to 80 MHz (ac coupled)
Gate Time	0.1 ms to 10 s in 6 decade steps
Resolution	0.1 Hz at 10 s gate time to 10 kHz at 0.1 ms gate
Accuracy	± 1 count ± timebase accuracy
Readout	kHz or MHz automatically displayed with decimal point

RATIO

Displays	f_1/f_2 where f_1 and f_2 are applied at the two input channels, A and B
Range f_1	DC to 80 MHz (dc coupled) 5 Hz to 80 MHz (ac coupled)
f_2	1 kHz to 10 MHz
Accuracy	± 1 count of signal on input A. ± trigger error of signal on input B*

PERIOD

Range	DC to 10 MHz (dc coupled) 5 Hz to 10 MHz (ac coupled)
Periods averaged	1 period to 10^5 periods
Frequency counted	100 kHz
Resolution	0.1 ns at 10^5 periods to 10 us at 1 period
Accuracy	± 1 count ± timebase accuracy, ± trigger error of signal on input A*
Readout	ms or us automatically displayed with decimal point

TIME INTERVAL

Range	0.1 us to 10^7 s (with 7 digit display) 0.1 us to 10^8 s (with 8 digit display)
Input	Channels A and B; common or separate
Resolution	0.1 us to 10 ms in 6 decade steps
Accuracy	± 1 count ± timebase accuracy ± trigger error**

* Trigger error is less than ± 0.3% - periods averaged for signals with better than 40 dB S/N ratio and greater than 100 mV rms amplitude.

** Trigger error is less than ± 0.0025 V/Signal Slope (V/us) in us.

TOTALIZING

Range	DC to 80 MHz (dc coupled)
Capacity	10^7 standard, up to 10^8 with 8 digit display
SELF CHECK	A timebase-derived 100 kHz signal is internally connected to the Channel A preamplifier output.

Input Signals

SENSITIVITY

Input A or B	Sinewave: 50 mV rms from dc to 50 MHz, decreasing to 75 mV rms at 80 MHz Pulse: 100 mV pulse amplitude with minimum pulse width of 20 ns.

IMPEDANCE

Input A or B	1 M ohm in parallel with 30 pF

ATTENUATOR

Input A and B only..... Sensitivity is decreased by a factor of 10 in the X10 position.

TRIGGER SLOPE

Input A and B only..... Front panel slide switch selects positive or negative slope triggering.

TRIGGER LEVEL

Input A and B only..... Front panel control has ± 1 V range when attenuator is in X1 position and ± 10 V in the X10 positions. Preset position is fully counterclockwise.

OVERLOAD CAPABILITY

Input A or B..... 150 V rms to 1 kHz (decreasing to 5 V rms at 80 MHz)
DC + Peak ac must not exceed 150 V

Output Signal

Marker Output..... A TTL Compatible (5 Volt) output is available for the duration of a time interval measurement at the rear panel BNC connector.

Time Base

INTERNAL

	Standard	Option -03
Frequency.....	10.00 MHz	10.00 MHz
Aging Rate.....	$< \pm 5 \times 10^{-7}$/mo	$< \pm 3 \times 10^{-7}$/mo
Temperature Stability		
20°C to 30°C.....	$< \pm 2 \times 10^{-6}$ typical	$\pm 5 \times 10^{-7}$ typical
0°C to 50°C.....	$< \pm 5 \times 10^{-6}$	$< \pm 2 \times 10^{-6}$
Line Voltage		
For ± 10% change.....	$< \pm 1 \times 10^{-7}$	$< \pm 1 \times 10^{-7}$

EXTERNAL

Frequency Required..... 10 MHz

Sensitivity..... 100 mV minimum

Impedance..... 1 M ohm, 15 pF

General

DISPLAY.....	7 digit LED display incorporating 0.27" high, seven segment characters. Up to 8 digits optionally available. Full leading zero suppression.
CYCLE RATE.....	When in the "CONT" mode, the time interval between successive measurements can be varied between 0.2 and 2.0 seconds by means of a CYCLE RATE control. RESET button clears display and activates a new measurement.
RESET.....	In "TRIG" mode the readings may be updated by pushing the RESET button.
POWER REQUIREMENTS.....	50, 60, 400 Hz; 115/230 V ± 10% (100 V operation available) 25 Watts
DIMENSION.....	2.94" high, 12.96" wide and 9.95" deep. (7.5 cm X 32.9 cm X 25.3 cm) See Figure 1-1.
WEIGHT.....	8 pounds (3.63 kg)

Environmental

STORAGE TEMPERATURE.....	$-40^{o}C$ to $+ 75^{o}C$
OPERATING TEMPERATURE.....	$0^{o}C$ to $+ 50^{o}C$

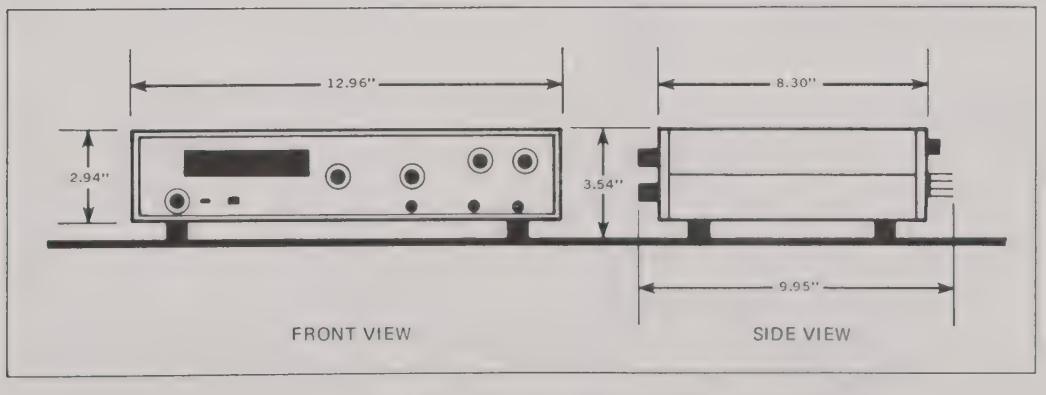
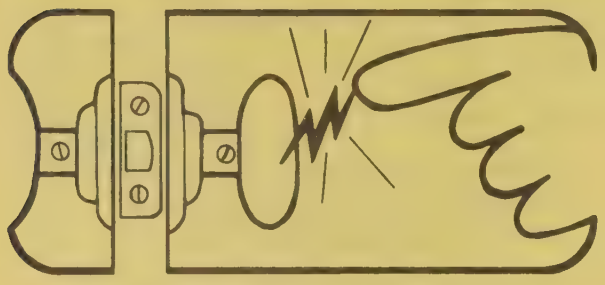


Figure 1-1. OUTLINE DRAWING

static awareness

A Message From

John Fluke Mfg. Co., Inc.

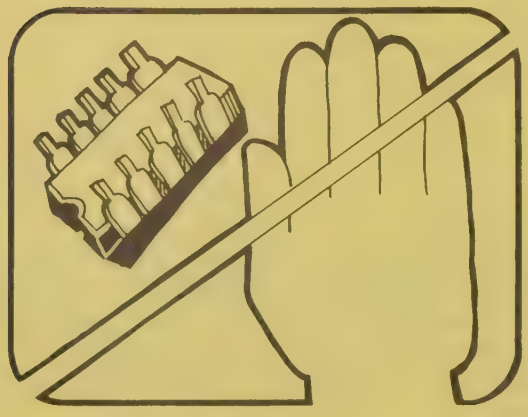


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

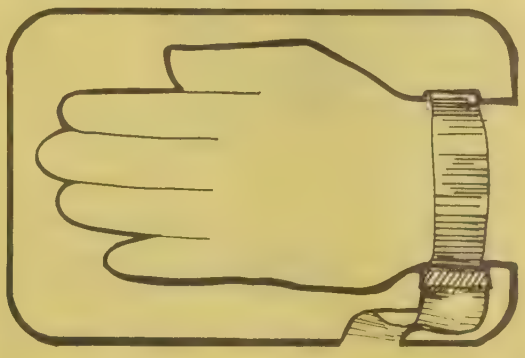
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗".

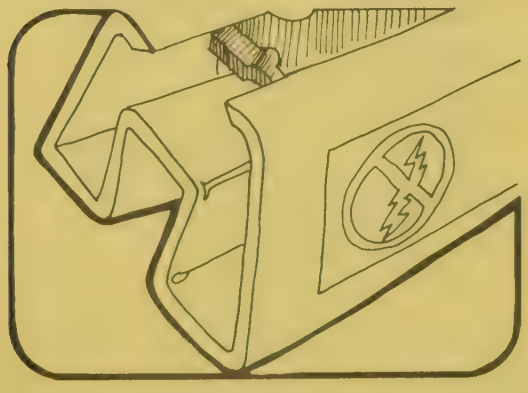
The following practices should be followed to minimize damage to S.S. devices.



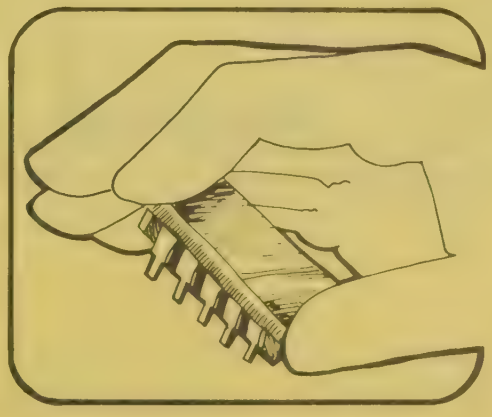
1. MINIMIZE HANDLING



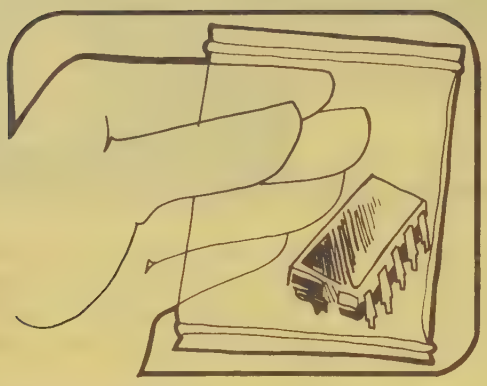
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



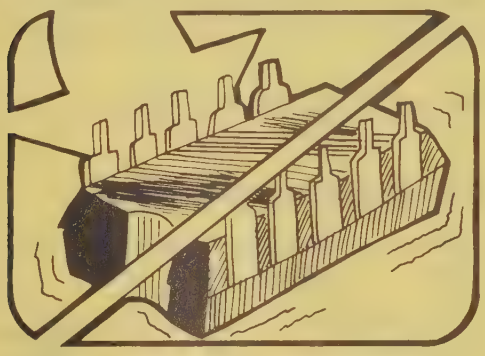
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



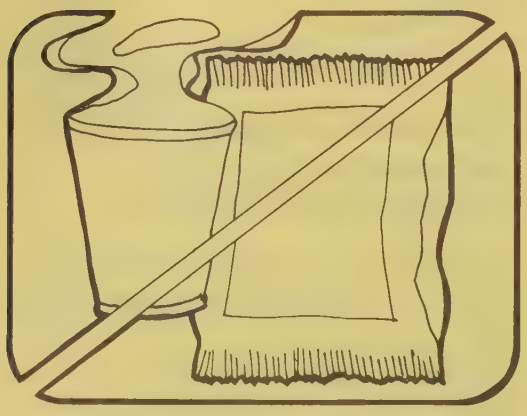
4. HANDLE S.S. DEVICES BY THE BODY



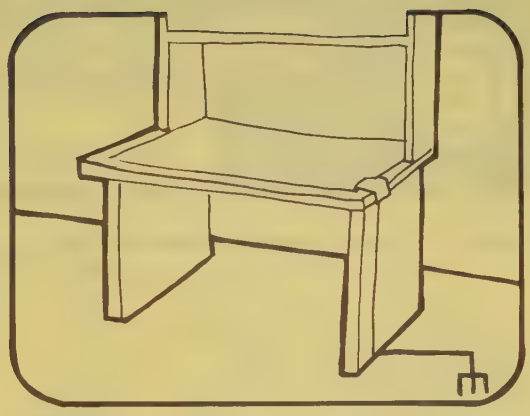
5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYRAFOAM IN WORK AREA



8. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION

9. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.

10. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Bag Size
453522	6" x 8"
453530	8" x 12"
453548	16" x 24"
454025	12" x 15"

Section 2

Operating Instructions

2-1 INTRODUCTION

2-2 This section of the manual contains information regarding installation and operation of the Model 1952B Counter. It is recommended that the contents of this section be read and understood before any attempt is made to operate the counter.

2-3 SHIPPING INFORMATION

2-4 The Model 1952B is packaged and shipped in a shock resistant container. Upon receipt of the equipment, a thorough inspection should be made to reveal any possible shipping damage. Special instructions for inspection and claims are included in the shipping carton.

2-5 If reshipment of the equipment is necessary, the original container should be used. If the original container is not available, a new container can be obtained from the John Fluke Mfg. Co., Ltd. Please reference the equipment model number when requesting a new shipping container.

2-6 INPUT POWER

2-7 The Model 1952B can be operated from a 115 or 230 V ac, 48 to 440 Hz power line (A 100/200 V ac version is available on request). Before connecting the equipment to primary power, check and, if necessary, set the instrument to operate at the local line voltage as follows:

a. Locate the input power selection switch on the rear panel of the 1952B.

b. Set the slide switch so that the desired voltage, 115 or 230, appears in the slide aperture.

c. Install the proper fuse (i.e. 1A slo-blo for 115 V ac and 0.5 A slo-blo for 230 V ac) in the rear panel fuse holder.

2-8 RACK INSTALLATION

2-9 The 1952B is designed for bench-top use or for installation in a standard 19 inch

equipment rack using the optional Accessory Rack Mounting Kit (part number M00-200-614).

2-10 OPERATING FEATURES

2-11 The function and location of all front panel controls, indicators and connectors are shown in Figure 2-1 and all rear panel controls, indicators and connectors are shown in Figure 2-2.

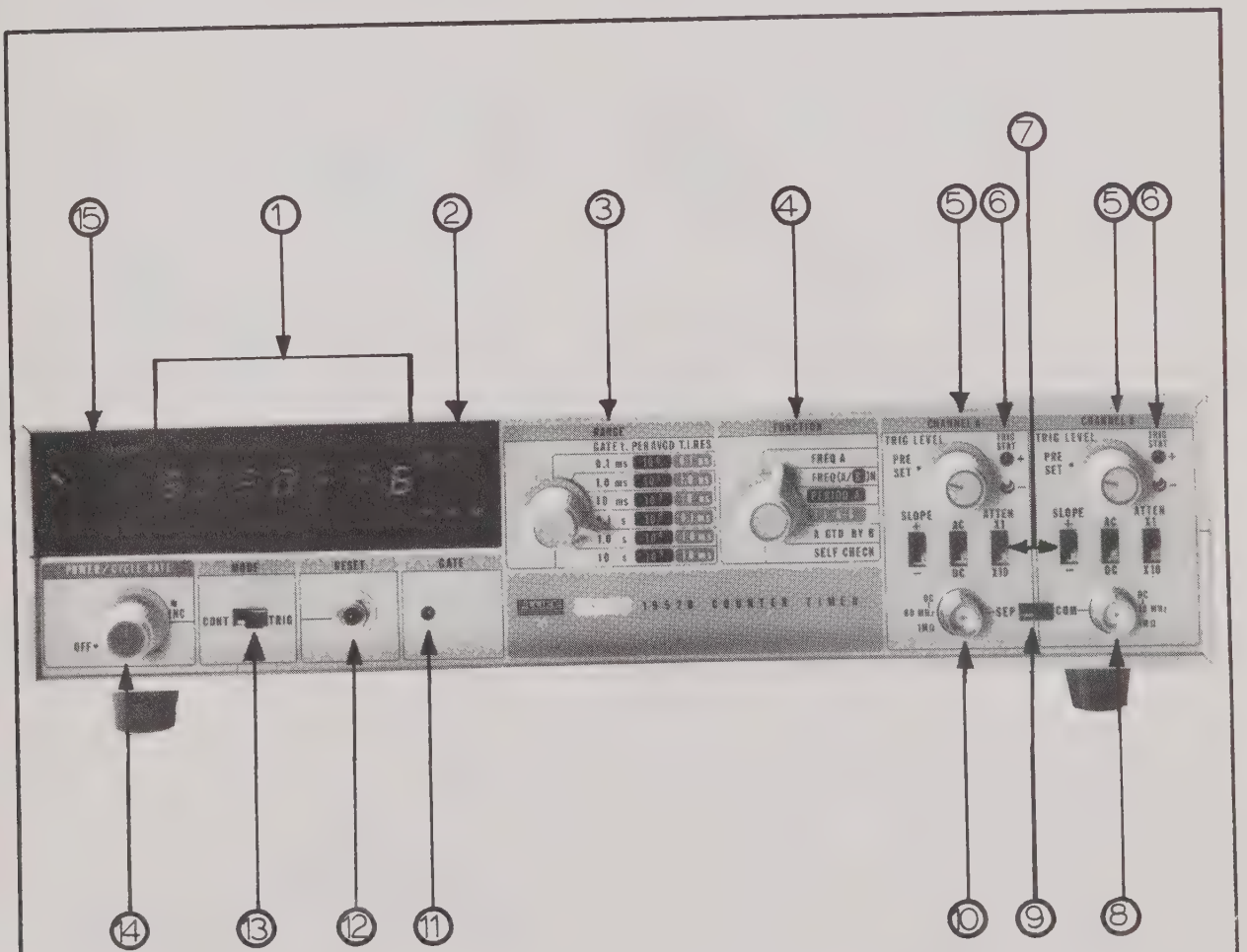


Figure 2-1 . FRONT PANEL CONTROLS , INDICATORS AND CONNECTORS .
(See pages 2-3,2-4 and 2-5 for ref. numbers)

REF. NO.	NAME	FUNCTION
1	Digital Display	Displays a seven digit readout of the counter measurement. The position of the RANGE and FUNCTION switches determine the location of the decimal point on the display. All decades are capable of displaying from 0 through 9.
2	Measurement Units	Displays a frequency or time multiplier necessary to properly define the value of the measurement readout. The multiplier displayed depends on the position of the RANGE and FUNCTION switches.
3	RANGE Switch	Selects one of six ranges for the selected operating function. GATE t..... Gate time ranges for frequency modes. PER.AVGD..... Number of periods averaged in PERIOD A mode. T.I, RES..... Resolution for T.I, A-B mode.
4	FUNCTION Switch	Selects the desired operating mode. FREQ. A..... Measures frequency of the CHANNEL A input signal. FREQ.(A/B)N..... Measures the frequency ratio of the CHANNEL A and B inputs. PERIOD A..... Measures the period of the CHANNEL A input signal. The number of periods averaged (10^0 through 10^5) are selected by the setting of the RANGE switch. T.I. A-B..... Measures the time interval between a start input signal at CHANNEL A and a stop input signal at CHANNEL B. A GTD. BY B..... Measures the number of events which occur on the CHANNEL A input when an enable signal is applied to the CHANNEL B input. The RANGE switch is not effective in this mode. SELF CHECK..... All inputs are disabled and an internally generated 100 kHz signal is counted and displayed.
5	Trigger Level Adjust	Sets the dc trigger level for the CHANNEL A/B input signal. With the control set to the PRESET position (maximum ccw) the trigger level is set to zero volts. Switched out of the detent position, the control can be set to cause triggering at positive or negative threshold voltages.

REF NO.	NAME	FUNCTION
6	Status Indicators + and - (CHANNEL A/B)	Two light emitting diodes (LED's) which illuminate on a mutually exclusive basis to indicate that the input signal is above or below the set trigger level. The illumination pattern is alternately reversed as the input signal passes above and below the trigger level threshold.
7	CHANNEL A and B Input Signal Conditioners	Slide switches which select the trigger Slope, Coupling and Attenuation for the respective CHANNEL A and B input signals. Slope..... (+ or -) Selects the leading or trailing edge slopes of the input signal for use in triggering the counter. Coupling..... Selects either direct DC coupling or capacitive AC coupling for the input signal. Attenuators..... (x1 or x10) Selects x1 or x10 attenuation of the input signal. In the x10 position the input sensitivity is reduced by a factor of 10.
8	CHANNEL B Input Connector	A BNC connector used to connect the CHANNEL B input signal to the counter.
9	SEP - COM Switch	A slide switch which electrically isolates or separates the CHANNEL A and B input signals in the SEP position, and electrically connects the inputs in the COM position.
10	CHANNEL A Input Connector	A BNC connector used to connect the CHANNEL A input signal to the counter.
11	GATE Indicator	An LED which illuminates to indicate that the counter is executing a measurement cycle.
12	RESET Switch	Momentary depression of the button resets the display to zero and initiates a new measurement.
13	CONT-TRIG Switch	Selects the internal (CONT) or external (TRIG) trigger method for initiating a new measurement. CONT..... Measurements are made on a continuous basis, one after another, separated by time delays dependent on the setting of the CYCLE RATE control. TRIG..... Measurements are initiated by a RESET pulse

		generated by momentarily depressing the RESET button.
14	CYCLE RATE	Determines the amount of time between successive measurements when the CONT - TRIG switch is in the CONT position. Also turns off the entire instrument in the CCW extreme (POWER OFF).
15	OVERFLOW Indicator	Illuminates to indicate that the counter has exceeded its total display capacity (overflowed).

2-12 OPERATING NOTES

2-13 The following paragraphs describe various conditions which should be considered before operating the Model 1952B Counter.

2-14 AC Line Connection

2-15 The input power cord is a three-pin polarized connector which permits connection to any of the power line voltages described in paragraph 2-6. Ensure that the offset pin is connected to a high quality earth ground. The 1952B Counter is energized by means of the front panel POWER/CYCLE RATE switch.

2-16 A and B Inputs

2-17 Input channels A and B are functionally similar. With the attenuators in the X1 position, the input impedance of each channel is 1 M ohm in parallel with 30 pF for signals less than 1 volt peak-to-peak, and decreases to 10 k ohm for signals that exceed 1 volt peak-to-peak. With the attenuators in the X10 position, the input resistance is 1 M ohm for all input signal levels.

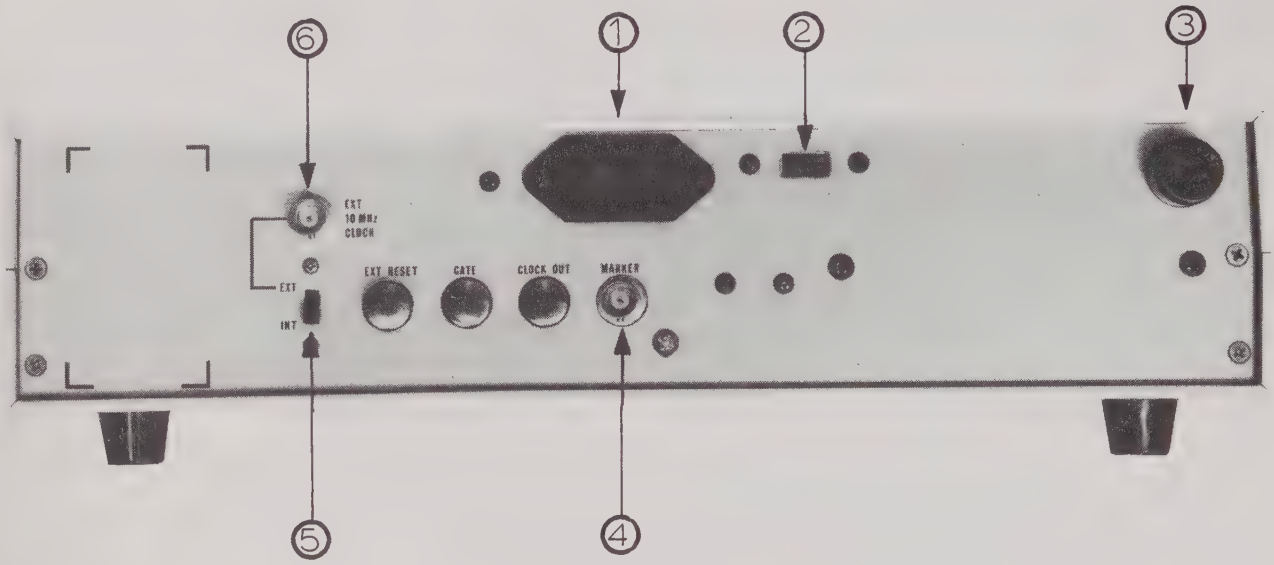
2-18 SEP - COM Switch

2-19 The SEP-COM (separate-common) switch is used to isolate the A and B inputs when the switch is in the SEP position, or to electrically connect the two inputs in the COM position. The switch is normally left in SEP position except for time interval measurements using a single input signal. With the switch in the COM position, CHANNEL A is used to establish the start trigger level conditions and the CHANNEL B is used to establish the stop trigger level conditions.

CAUTION!

If separate signal sources are to be connected to the A and B input, the SEP-COM switch should be set to the SEP position. Otherwise the outputs of the signal sources will be shorted together.

Figure 2-2. REAR PANEL CONTROLS , INDICATORS AND CONNECTORS .



REF NO.	NAME	FUNCTION
1	Power Input Connector	Provides the means of connecting the instrument through the power cord to line power.
2	115/230 Power Select Switch	Provides rear panel selection of 115 or 230 V ac input power.
3	FUSE	Protects the ac input section of the power supply.
4	MARKER Connector	Provides for external connection to the Marker output signal. This signal is used to modulate the Z axis on an oscilloscope while displaying the input signal. The result is an intensified zone which displays the start to stop interval for a time interval measurement.
5	Clock Select Switch	Selects the internal or external clock for use as the counter time base. INT..... Selects the internal 10 MHz clock. EXT..... Selects the external clock input signal connected to the EXT 10 MHz clock connector.
6	EXT 10 MHz Connector	Provides for the connection of an external 10 MHz clock input signal. The minimum input level requirement is 150 mV and the input impedance is 1 M ohm.

2-20 Trigger Levels

2-21 The front panel trigger level controls provided for each CHANNEL A and B input consist of three slide switches, two LED Status Indicators and a manual Trigger Level Adjust. The slide switches condition the input signal before it is used to trigger the counter by selecting the desired trigger slope (+ or -), coupling (AC or DC) and attenuation (x1 or x10). The Trigger Level Adjust is then used to set the dc threshold of an internal trigger circuit and thereby define the trigger level for the channel input signal. The range of the trigger level control is continuously variable from + 1 to - 1 V dc with the attenuator switch in the x1 position. Selecting the x10 attenuator increases the trigger level voltage range by a factor of 10. When the trigger level control is turned CCW to the PRESET detent, the trigger level is set to 0 V dc. The two Status Indicators provide a convenient method of determining the effective operating range of the trigger level control for a given input signal. Assuming a sinewave input is used, both LED's are illuminated to an equal intensity when the trigger level control is adjusted to trigger at 0 V dc. For non-symmetrical input signals triggering occurs when both LED's are illuminated regardless of intensity. Very narrow low frequency pulses may not illuminate the Status Indicators even though proper triggering occurs.

2-22 MARKER Output

2-23 In the Time Interval mode, a pulse is generated at the rear panel MARKER output connector to provide an indication of the actual time interval being measured. The width of the MARKER pulse is variable depending on the time interval of the signal being measured and the trigger level settings for CHANNELS A and B (Start and Stop). When the measured input signal is fed to the vertical input of an oscilloscope, the MARKER pulse can be used to modulate the Z axis of the scope and cause the measured portion of the input signal to be intensified. Using this technique, the thresholds for the A and B (Start and Stop) Trigger Levels can be individually adjusted for precise time interval measurements.

2-24 In the Frequency A mode, the Marker pulse can be used to precisely set the A trigger level. However, the Channel B Trigger Level controls must also be adjusted to reset the Marker generator. This is accomplished by setting the SEP - COM switch to the COM position and adjusting the B Trigger Level so that the intensified zone is terminated shortly after it begins. Adjust the Channel A Trigger Level to the desired position.

2-25 OPERATION

2-26 Turn-On Procedure

2-27 Use of the following procedure is suggested for initial turn-on of the 1952B Counter:

a. Connect the counter to the ac power line. (See paragraph 2-6).

b. Turn the POWER/CYCLE RATE switch clockwise and out of the power OFF detent. The front panel display should illuminate.

2-28 Operating Modes

2-29 The following paragraphs describe the self check, frequency, ratio, period, time interval and totalize functions and the procedures necessary to operate the 1952B in each mode.

2-30 SELF CHECK

2-31 The SELF CHECK function is used to verify the overall operation of Model 1952B. The Frequency of a 100 kHz clock, derived from the 10 MHz oscillator, is measured to produce a predictable readout for each setting of the GATE t switch.

2-32 Use the following procedure to operate the Model 1952B in the SELF CHECK mode:

a. Turn the CYCLE RATE switch clockwise out of the power OFF detent.

b. Set the rear panel Clock Select Switch to the INT (internal) position.

c. Set the FUNCTION switch to the SELF CHECK position.

d. Set the MODE switch to the CONT position.

e. Set the CYCLE RATE control for the desired display period.

f. Refer to Table 2-1 and verify the display readout for each GATE t setting of the RANGE switch.

Table 2-1 DISPLAY READOUT FOR SELF CHECK MODE

GATE t SETTINGS	NUMERIC READOUT
0.1 ms	10
1.0 ms	100
10 ms	1000
0.1 s	10000
1.0 s	100000
10 s	1000000

2-33 FREQUENCY

2-34 Standard frequency measurements from 0 to 80 MHz are made using the FREQUENCY A operating mode. The GATE times available for each frequency measurement range from 0.1 ms to 10 s in power of ten steps and are selected by the setting of the RANGE switch. The RANGE switch is set to provide optimum resolution of the displayed frequency.

2-35 Use the following procedure to operate the Model 1952B in the FREQ A mode:

a. Turn the CYCLE RATE switch clockwise out of the POWER OFF detent.

b. Set the FUNCTION switch to the FREQUENCY A position.

c. Set the MODE switch to the CONT position.

d. Connect the input signal to be measured to the CHANNEL A Input Connector.

e. Adjust the CHANNEL A Trigger Level Adjust to establish the desired trigger conditions. Proper triggering occurs when the + and - Status Indicators are both illuminated.

f. Adjust the CYCLE RATE control for the desired display period.

g. Obtain optimum resolution of the frequency displayed by selecting the proper GATE t setting on the RANGE switch.

2-36 RATIO

2-37 In the FREQ (A/B)N mode the frequency ratio of two input signals A and B can be measured. The resolution of the measurement can be increased by the factor N in decade steps by changing the setting of the RANGE Switch. Optimum resolution is obtained by ensuring that the higher frequency is used for the CHANNEL A input.

2-38 Since a decimal point is not displayed in the FREQ (A/B)N mode, its location is determined by noting the exponent of the PER.AVGD range switch setting and, starting to the right of the least significant digit on the display, shifting the decimal point that many places to the left.

2-39 Use the following procedure to operate the Model 1952B in the ratio mode:

a. Turn the CYCLE RATE switch clockwise out of the POWER OFF detent.

b. Set the FUNCTION switch to FREQ (A/B)N.

c. Set the MODE switch to the CONT position.

d. Set the SEP - COM switch to the SEP position.

e. Connect the higher frequency to be measured to the CHANNEL A input.

f. Connect the lower frequency to the CHANNEL B Input Connector.

g. Rotate the CHANNEL A and B Trigger Level Adjusts to establish the desired trigger conditions. Proper triggering occurs when both Status Indicators are alternately illuminated.

h. Adjust the CYCLE RATE control for the desired display period.

i. If necessary, resolution of the displayed ratio is increased by advancing the RANGE switch in a clockwise direction.

j. Locate the decimal point using the method described in the previous paragraph.

2-40 PERIOD

2-41 The period function is used to make single or multiple period average measurements for input frequencies up to 10 MHz. This mode is intended for use with low frequencies where maximum resolution is desired. For example, if the 10^0 PER range is selected and an input frequency of 1 Hz is applied to CHANNEL A input, the display will read 1000.00 ms. Switching the RANGE switch to the 10^1 PER AVGD position will cause the display to read 1000.000 ms. The selected setting of the RANGE switch indicates, in powers of ten, the number of periods of the input signal which are sampled to produce a final display.

2-42 Use the following procedure to operate the Model 1952B in the period average mode:

a. Turn the CYCLE RATE control clockwise out of the POWER OFF detent.

b. Set the FUNCTION switch to PERIOD A.

c. Set the MODE switch to the CONT position.

d. Set the SEP - COM switch to SEP.

e. Connect the frequency to be measured to the CHANNEL A Input Connector.

f. Adjust the CHANNEL A Trigger Level Adjust to ensure proper triggering.

g. Adjust the CYCLE RATE control for the desired display period.

h. Using the RANGE switch select the PER AVGD setting which provides optimum resolution.

2-43 TIME INTERVAL

2-44 In the time interval function, accurate time measurements can be made between the occurance of two separate input signals or between two points on a single input signal. The trigger level and slope for the start input is detected using CHANNEL A and the stop input is detected using CHANNEL B. When a single input signal is used to provide both the start and stop events the SEP - COM switch is set in the COM position so that both CHANNELS A and B receive the same signal. The SEP - COM switch is set to the SEP position when the start and stop input signals are available as separate input signals.

2-45 Accurate pulse width, rise time and fall time measurements can be made using the time interval function. However, their accuracy depends on the start and stop trigger levels being set

to occur at precise voltage levels of the input signal. These levels can be visually set using an oscilloscope to display the input signal while modulating the Z axis scope input with the Marker output signal available at the rear of the 1952B. The measured time interval appears as an intensified zone on the scope trace and can be adjusted using the CHANNEL A and B Trigger Level controls. Refer to MARKER output discussion given earlier in this section under Operating Notes.

2-46 Use the following procedure to operate the Model 1952B in the time interval function:

a. Turn the CYCLE RATE control clockwise out of the POWER OFF detent.

b. Set the CONT - TRIG switch to the CONT position.

c. Set the FUNCTION switch to T.I. A-B.

d. Set the SEP - COM switch to the SEP position if separate start/stop inputs are used, or to COM if the start/stop inputs are derived from a single input signal.

e. If separate input signals are used, connect the start signal to the CHANNEL A input and the stop signal to the CHANNEL B input. If a single input is used connect it to the CHANNEL A input.

f. Adjust the CHANNEL A and B Trigger Levels to establish the desired start/stop trigger points. Use the MARKER output pulse in conjunction with an oscilloscope to establish precise trigger levels.

g. Adjust the CYCLE RATE control for the desired display period.

h. Using the RANGE switch, select the T.I. RES setting which provides the desired resolution.

2-47 TOTALIZING

2-48 In the A GTD.BY B function the Model 1952B can be used as a gateable totalizer. Each triggerable event which occurs on the CHANNEL A input is accumulated or totalized while a gate pulse is present at the CHANNEL B input. The CHANNEL B gate pulse assumes an active high state when the associated slope switch is set to the positive (+) position and an active low state when the slope switch is set to the negative (-) position. In this mode the RANGE switch is not functional.

2-49 Use the following procedure to operate the Model 1952B in the totalize function:

a. Turn the CYCLE RATE control clockwise out of the POWER OFF detent.

b. Set the FUNCTION switch to the A GTD.BY B position.

c. Set the SEP - COM switch to the SEP position.

d. Connect the signal to be counted or totalized to the CHANNEL A Input Connector.

e. Connect the gate pulse to the CHANNEL B Input Connector.

f. Adjust the CHANNEL A and B Trigger Level Adjust to ensure proper triggering. The counter will totalize event inputs on CHANNEL A as long as the CHANNEL B input is at an active level. In this mode the display will reset only when the manual RESET is activated.

NOTE!

If no input signal to channel B is required or available, the gating of the accumulator can be manually controlled by the CHANNEL B SLOPE switch. Turn the CHANNEL B TRIGGER LEVEL control fully cw. Setting the SLOPE switch for CHANNEL B to - will now gate the accumulator, and the 1952B will totalize. Setting it back to + will inhibit the accumulator, and the totalizing will halt. To resume totalizing, set the SLOPE switch to - again; to start over from zero, momentarily press the RESET switch.

Section 3

Theory of Operation

3-1 INTRODUCTION

3-2 This section of the manual contains an overall functional description followed by a detailed block diagram analysis of the Model 1952B Digital Counter-Timer. Simplified block diagrams and timing diagrams are included, as necessary, to supplement the text.

3-3 OVERALL FUNCTIONAL DESCRIPTION

3-4 The Fluke Model 1952B, as shown in the simplified block diagram of Figure 3-1, is a

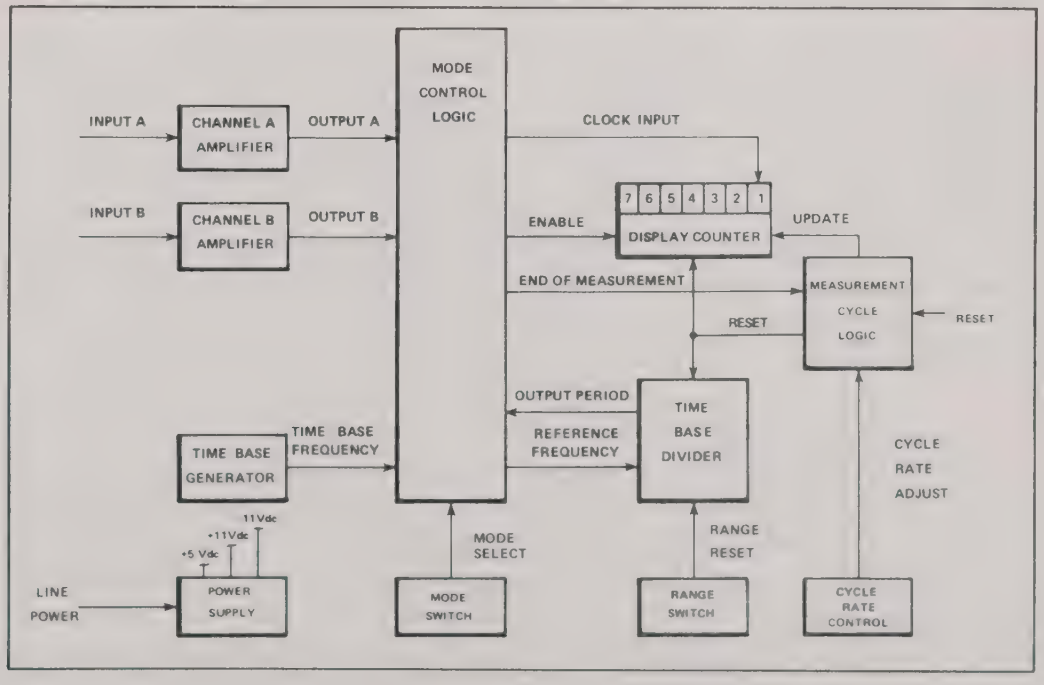


Figure 3-1 . MODEL 1952B , SIMPLIFIED BLOCK DIAGRAM .

universal counter/timer capable of making frequency, frequency ratio, period average, time interval and totalize measurements. Each measurement mode and six associated ranges are individually selectable from the front panel. Separate CHANNEL A and B inputs provide the trigger levels controls necessary to condition input frequencies from 0 to 80 MHz. All measurements are displayed on a seven decade LED display along with range annunciators and decimal point, when applicable. The time between successive measurements can be adjusted on a continuous basis.

3-5 The input signals for all operating modes are conditioned for use by the CHANNEL A and B amplifiers. These amplifiers condition their input signals by providing AC or DC coupling, x1 or x10 attenuation, + or - slope trigger selection, and continuously variable positive or negative threshold voltage adjustments for trigger level control. A series of high gain amplifiers square the leading and trailing edges of the input signal to provide a digital pulse train representative or the input frequency. The pulse train is interfaced to provide the amplifier with output voltage levels which are TTL compatible.

3-6 The Mode Control Logic accepts the outputs of the CHANNEL A and B amplifiers along with the output of a precision Time Base Generator, and depending on the position of the FUNCTION switch, routes them to the Time Base Divider and/or the Display Counter. The Time Base Divider, when used, divides the Reference Frequency by a selectable power of 10 to provide an Output Period equal to 10^0 through 10^5 periods of the Reference Frequency. The selected Output Period controls the time during which the other input frequency is allowed to accumulate or totalize in the Display Counter before being displayed. The Time Base Divider is not used in the A GTD BY B mode. Instead the output of the CHANNEL B amplifier is used to determine the time during which the Display Counter is enabled.

3-7 The Measurement Cycle Logic controls the time between successive measurements, and provides the Display Counter with an Update and Reset command following each measurement cycle. When a measurement is completed, the Display Counter is disabled and an End of Measurement (EOM) command is sent to the Measurement Cycle Logic. The EOM command enables the Cycle Logic causing it to sequentially generate the display Update and Reset pulses. The time between the two pulses is variable depending on the position of the CYCLE RATE control. The display Update pulse enables the display memory to enter the data currently contained in the counter. The new data is immediately transferred to the display LED's. When the cycle rate period is elapsed, the Reset pulse is generated to reset the counter and start a new measurement.

3-8 The Display Counter, when enabled, counts or accumulates each Clock Input pulse received from the Mode Control Logic. The counters are arranged in decade-series fashion and are capable of accumulating nine counts in each of the seven available decades. When the counters are disabled at the end of a measurement, the accumulated data is transferred to a display memory by the action of the Update pulse from the Measurement Logic. The new contents of the updated memory immediately appears on the LED display. As a new measurement is initiated, the Reset pulse resets the counters to zero but does not affect the memory or display. Included on the display are decimal point and measurement units information derived from the FUNCTION and RANGE switch settings.

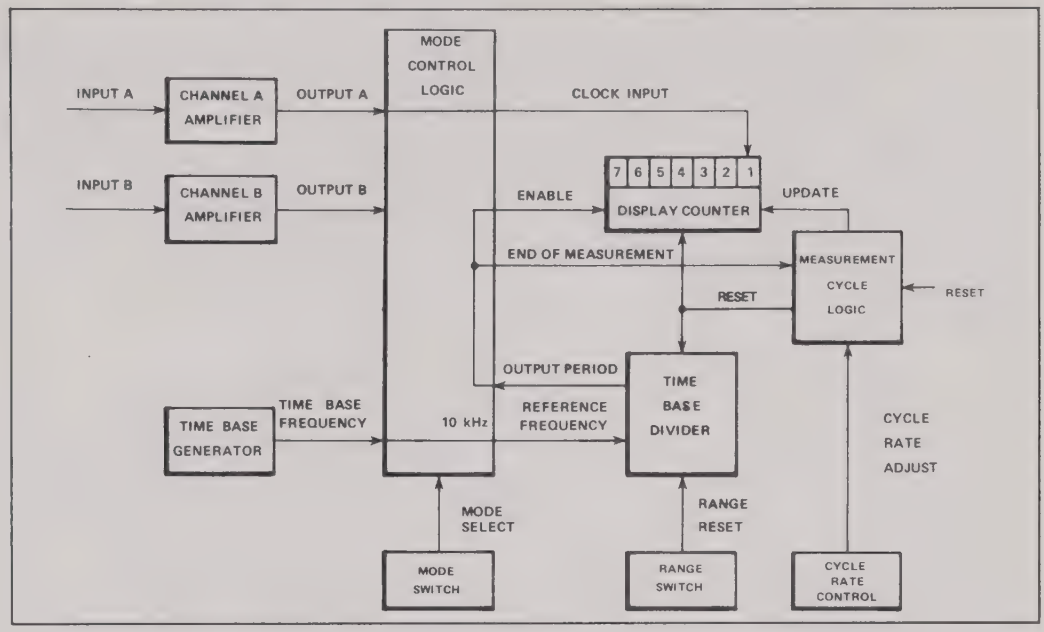


Figure 3-2 . FREQUENCY A FUNCTION,SIMPLIFIED DATA FLOW CHART .

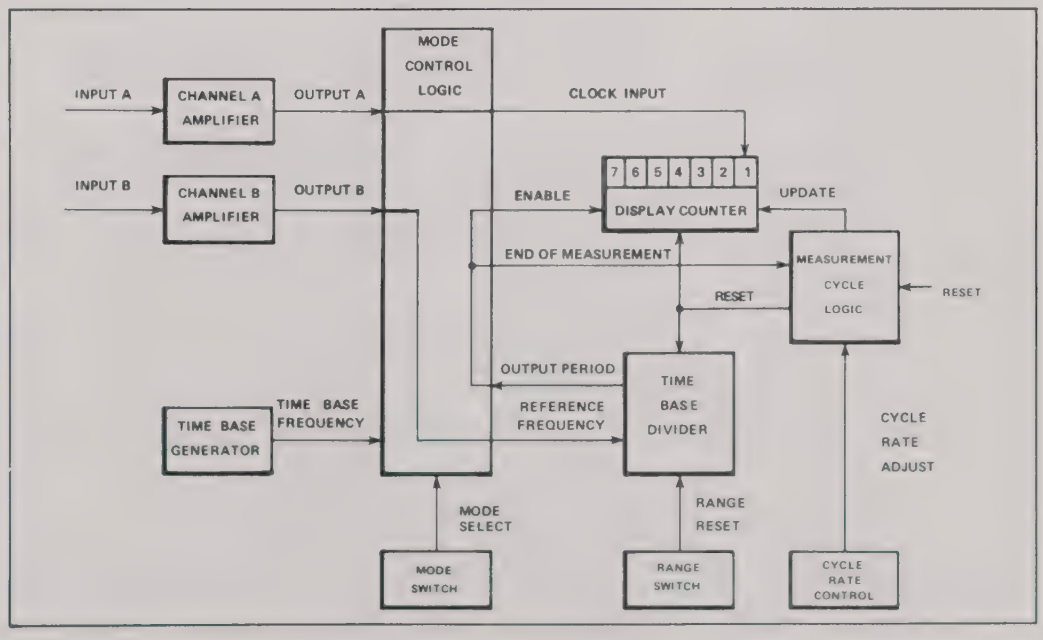


Figure 3-3 . FREQUENCY (A/B)N FUNCTION,SIMPLIFIED DATA FLOW CHART .

3-9 Frequency Mode

3-10 In the frequency mode the counter assumes the configuration shown in Figure 3-2. The input frequency is applied at Input A and routed through the Mode Control Logic to provide the Input Clock for the Display Counter. A 10 kHz Time Base Frequency derived from the Time Base Generator is used as the Reference Frequency for the Time Base Divider. The resulting Output Period generated by the Time Base Divider is selectable by powers of 10 (0.1 ms to 10 s) using the RANGE switch. The precise Output Period is used to enable the Display Counter and allow the Clock Input to accumulate for the specified time. The accumulated count is then displayed as frequency. Frequency resolution is increased as the Output Period of the Time Base Divider is increased.

3-11 Ratio Mode

3-12 In the FREQ (A/B)N mode, ratio measurements are made using the configuration shown in Figure 3-3. The Input A frequency is routed through the Mode Control Logic and used as the Clock Input for the Display Counter. The Input B frequency is routed through the Mode Control Logic and is used as the Reference Frequency to the Time Base Divider. The output of the Time Base Divider can be selected by the RANGE switch to provide an Output Period equal to from 10^0 to 10^5 periods of the Reference Frequency. The selected Output Period enables the Display Counter and as a result, the Input A frequency is accumulated for the duration of the Output Period. At the end of the Output Period the Display Counter is disabled and the EOM signal is generated.

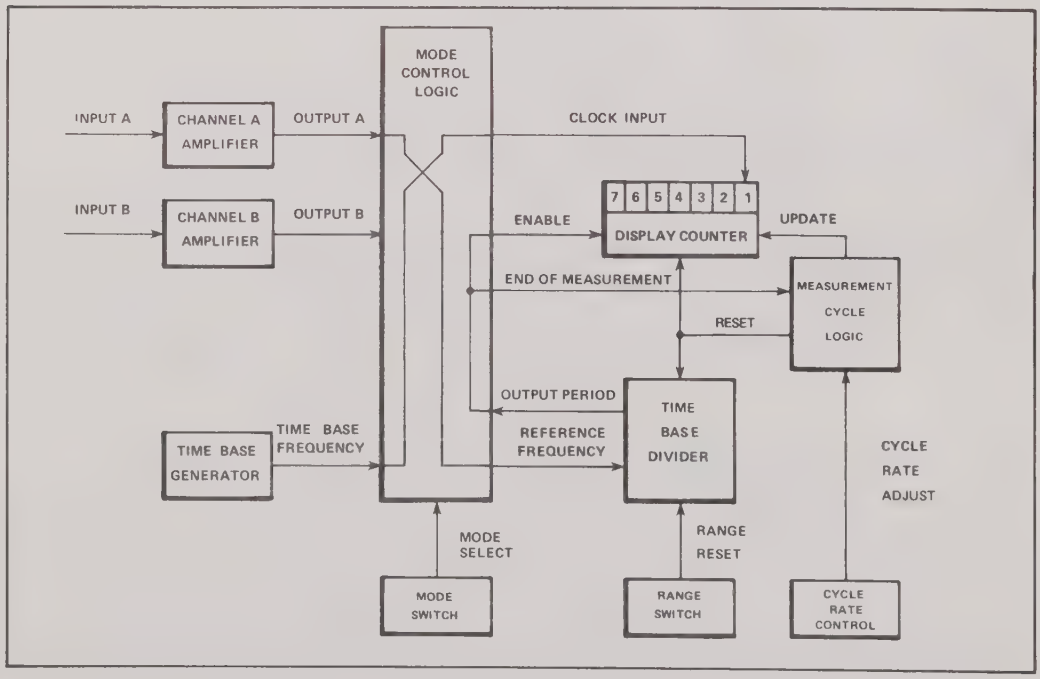


Figure 3-4 . PERIOD A FUNCTION,SIMPLIFIED DATA FLOW CHART .

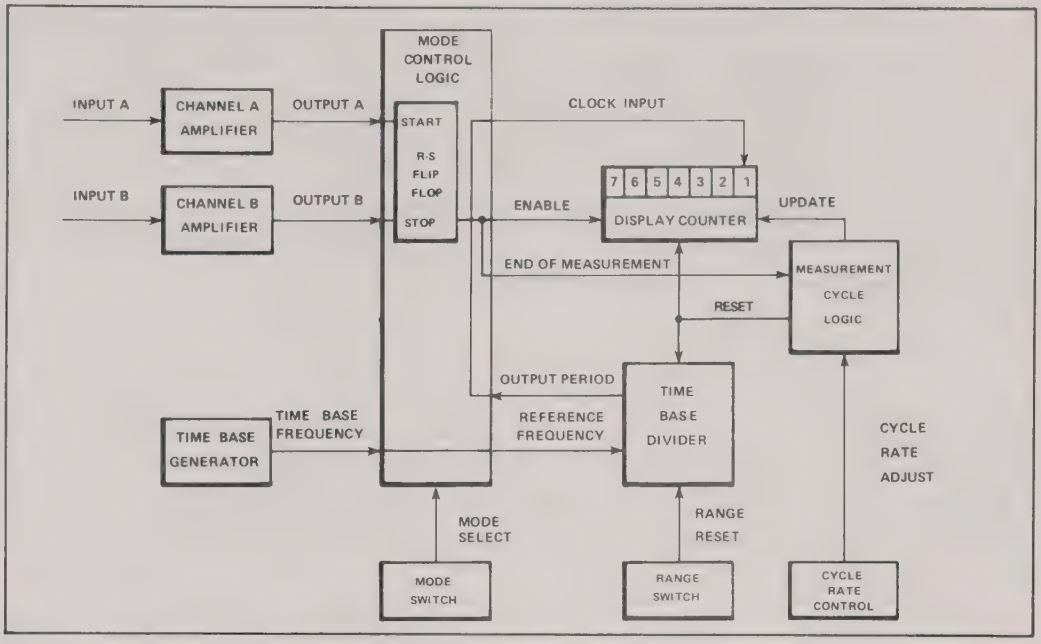


Figure 3-5 . TIME INTERVAL FUNCTION,SIMPLIFIED DATA FLOW CHART .

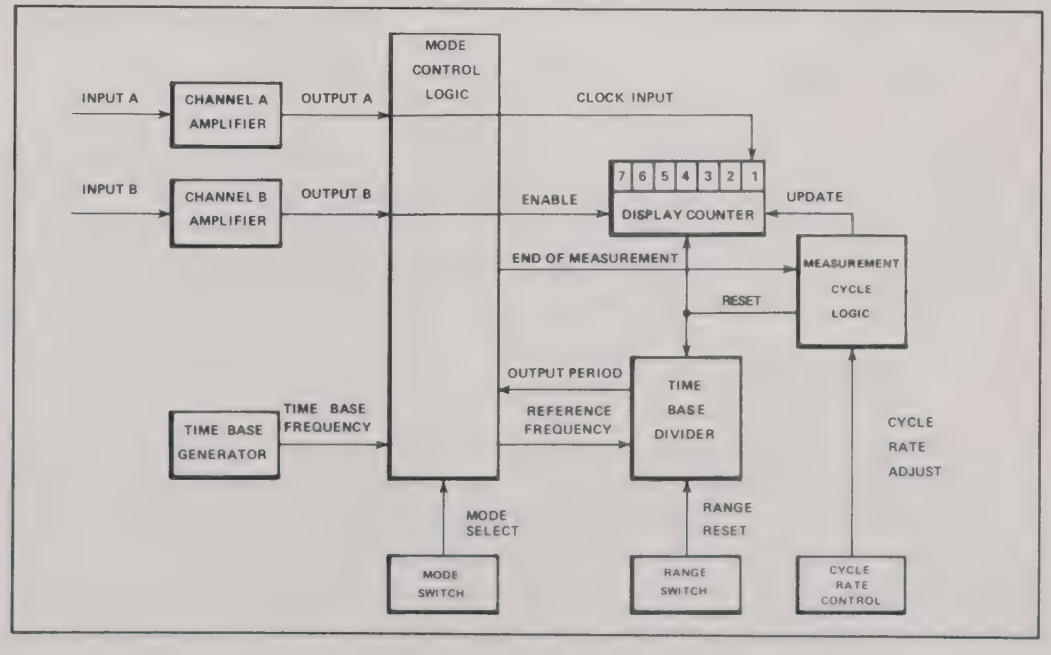


Figure 3-6 . TOTALIZE FUNCTION,SIMPLIFIED DATA FLOW CHART .

3-13 Period Mode

3-14 In the period mode, as shown in Figure 3-4, a 100 kHz signal from the Time Base Generator is routed through the Mode Control Logic and is used as the Clock Input to the Display Counter. This 100 kHz clock is totalized by the counter for multiple periods of the Input A signal. The Time Base Divider receives the Input A signal as the Reference Frequency and provides a timed Output Period equal to 10^0 through 10^5 periods of the Reference Frequency. The duration of the Output Period is selectable using the RANGE switch. At the end of the selected Output Period, the Display Counter is disabled and the EOM signal is generated.

3-15 Time Interval

3-16 In the Time Interval mode, as shown in Figure 3-5, the Display Counter accumulates Clock Input pulses for a time interval started by Input A and stopped by Input B. The Clock Input, as received from the Time Base Divider, is selectable by powers of 10 from 10 MHz to 100 Hz. The Reference Frequency for the Time Base Divider is derived from the 10 MHz output of the Time Base Generator.

3-17 The first input transition detected by the CHANNEL A Amplifier sets an R-S flip-flop in the Mode Control Logic and Enables the Display Counter to start accumulating Clock Input pulses. Some time later, the first input transition detected by the CHANNEL B Amplifier resets the R-S flip-flop and disables the Display Counter. At the same time the End of Measurement signal is generated. The accumulated Clock Input pulses give a direct indication of the time interval between the detection of the A and B input signals.

3-18 Totalize Mode

3-19 In the A GTD BY B mode, as shown in Figure 3-6, an Enable signal derived from Input B allows the Display Counter to totalize the Clock Input pulses derived from Input A. The counter, when repeatedly enabled and disabled using the Input B signal, is not reset. Instead, it sequentially totalizes the Clock Input pulses which occur during each enable period. The Display Counter is reset upon receipt of an external Reset command.

3-20 Self Check Mode

3-21 In the Self Check Function, as shown in Figure 3-7, the logic portion of the 1952B is exercised by the Time Base Generator to verify the overall operation of the counter. The 10 kHz output of the Time Base Generator is processed by the Time Base Divider to provide an Output Period which is selectable in powers of 10 time intervals from 0.1 ms to 10 seconds. The selected time interval (GATE t) is used to Enable the counter and allow a 100 kHz Clock Input, also from the Time Base Generator, to be totalized. When the logic portion of the 1952B is operating properly, the totalized count displayed should be 10, 100, 1000, 10000, 100000 or 1000000 depending on the position of the RANGE switch.

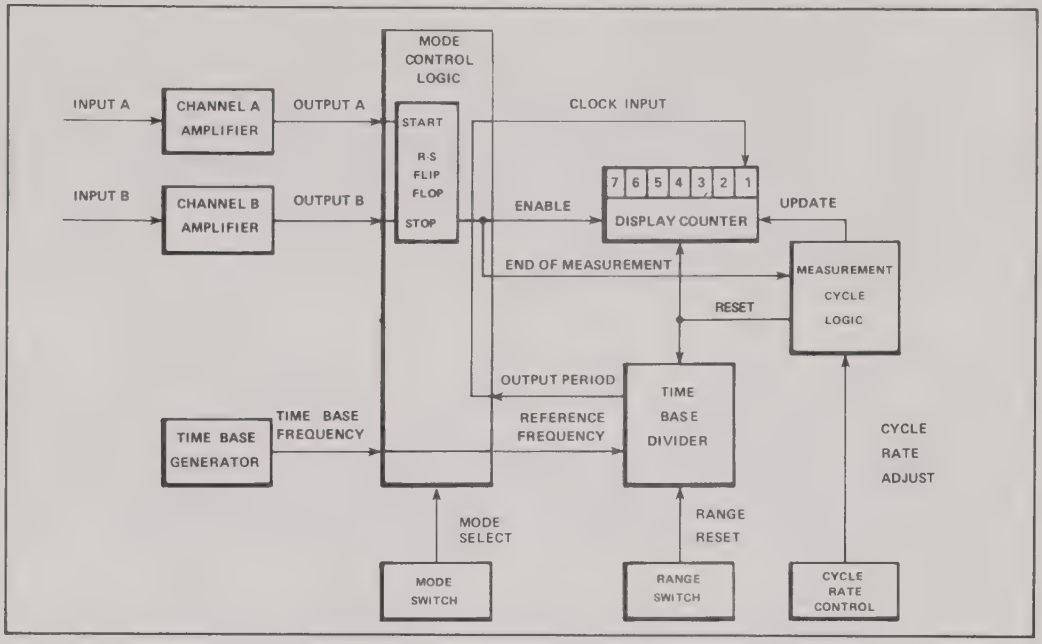


Figure 3-5 . TIME INTERVAL FUNCTION,SIMPLIFIED DATA FLOW CHART .

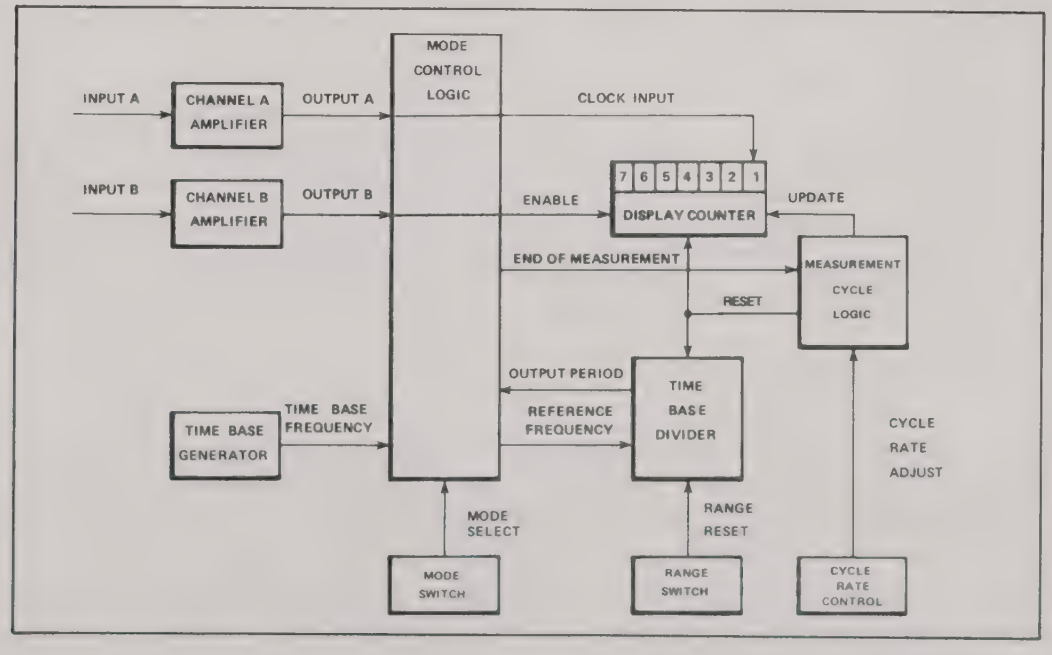


Figure 3-6 . TOTALIZE FUNCTION,SIMPLIFIED DATA FLOW CHART .

3-13 Period Mode

3-14 In the period mode, as shown in Figure 3-4, a 100 kHz signal from the Time Base Generator is routed through the Mode Control Logic and is used as the Clock Input to the Display Counter. This 100 kHz clock is totalized by the counter for multiple periods of the Input A signal. The Time Base Divider receives the Input A signal as the Reference Frequency and provides a timed Output Period equal to 10^0 through 10^5 periods of the Reference Frequency. The duration of the Output Period is selectable using the RANGE switch. At the end of the selected Output Period, the Display Counter is disabled and the EOM signal is generated.

3-15 Time Interval

3-16 In the Time Interval mode, as shown in Figure 3-5, the Display Counter accumulates Clock Input pulses for a time interval started by Input A and stopped by Input B. The Clock Input, as received from the Time Base Divider, is selectable by powers of 10 from 10 MHz to 100 Hz. The Reference Frequency for the Time Base Divider is derived from the 10 MHz output of the Time Base Generator.

3-17 The first input transition detected by the CHANNEL A Amplifier sets an R-S flip-flop in the Mode Control Logic and Enables the Display Counter to start accumulating Clock Input pulses. Some time later, the first input transition detected by the CHANNEL B Amplifier resets the R-S flip-flop and disables the Display Counter. At the same time the End of Measurement signal is generated. The accumulated Clock Input pulses give a direct indication of the time interval between the detection of the A and B input signals.

3-18 Totalize Mode

3-19 In the A GTD BY B mode, as shown in Figure 3-6, an Enable signal derived from Input B allows the Display Counter to totalize the Clock Input pulses derived from Input A. The counter, when repeatedly enabled and disabled using the Input B signal, is not reset. Instead, it sequentially totalizes the Clock Input pulses which occur during each enable period. The Display Counter is reset upon receipt of an external Reset command.

3-20 Self Check Mode

3-21 In the Self Check Function, as shown in Figure 3-7, the logic portion of the 1952B is exercised by the Time Base Generator to verify the overall operation of the counter. The 10 kHz output of the Time Base Generator is processed by the Time Base Divider to provide an Output Period which is selectable in powers of 10 time intervals from 0.1 ms to 10 seconds. The selected time interval (GATE t) is used to Enable the counter and allow a 100 kHz Clock Input, also from the Time Base Generator, to be totalized. When the logic portion of the 1952B is operating properly, the totalized count displayed should be 10, 100, 1000, 10000, 100000 or 1000000 depending on the position of the RANGE switch.

3-22 BLOCK DIAGRAM ANALYSIS

3-23 General

3-24 A block diagram analysis of the functional circuits of the 1952B is given in the following paragraphs. The circuits described correspond to the functional blocks defined in Figure 3-1. Detailed schematics are included at the rear of the manual.

3-25 Power Supply

3-26 The Power Supply consists of a 115/230 V ac transformer, associated switches, fuse, power input connector and regulating circuitry. The function of the power supply is to provide + 5 + 11 and - 11 V dc regulated operating voltages for the 1952B circuitry. The + 5 V dc is used to operate the digital portion of the circuitry while the + 11 and - 11 V dc supplies operate the analog portion of the circuitry. All three operating voltages are generated using conventional isolating and regulating techniques. Refer to the schematic, 1952B - 1001, at the rear of this manual.

3-27 Line power to the power supply is received through the rear panel Input Power Connector, Fuse F1, the front panel CYCLE RATE (power) switch and the 115/230 Voltage select switch. The front panel display illuminates when the regulated + 5 V dc is present.

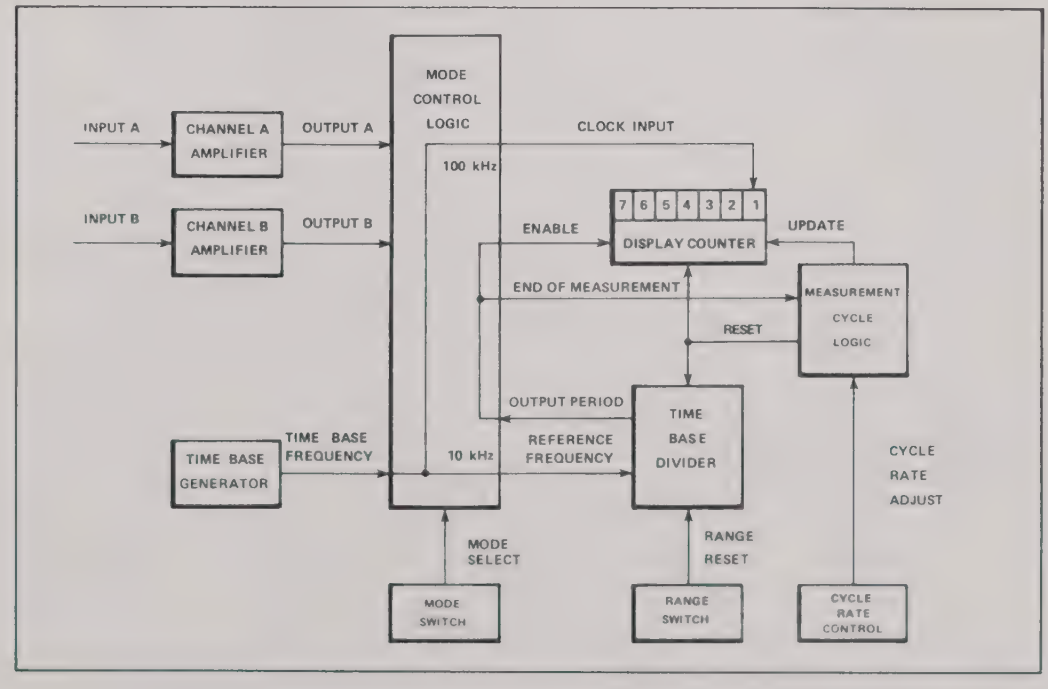


Figure 3-7 . SELF CHECK FUNCTION,SIMPLIFIED DATA FLOW CHART .

3-28 Mode Control Logic

3-29 The mode Control Logic as shown in the schematic at the rear of this manual is controlled by the position of the front panel FUNCTION switch. The truth table given in the schematic defines Inputs to the Mode Control Logic which are required to interconnect the various functional blocks of the 1952B and thus configure each particular operating mode. Each of the possible mode configurations are defined earlier in this section under the overall functional description.

3-30 Channel A and B Amplifiers

3-31 The CHANNEL A and B Amplifiers are electrically similar. Therefore, an analysis of the CHANNEL A amplifier is sufficient to describe both amplifiers.

3-32 The CHANNEL A Amplifier, as shown in Figure 3-8, consists of a high gain differential amplifier, input coupling and attenuator circuits, a Trigger Level Adjust circuit, Slope switch, Status indicators and an inverter. The function of the CHANNEL A Amplifier is to define an acceptable input signal and to produce a TTL compatible, output pulse for each acceptable Input cycle that occurs.

3-33 In operation, front panel slide switches permit the Input signal to be AC or DC coupled and attenuated by a factor of 1 or 10 before being delivered as an input to the high gain

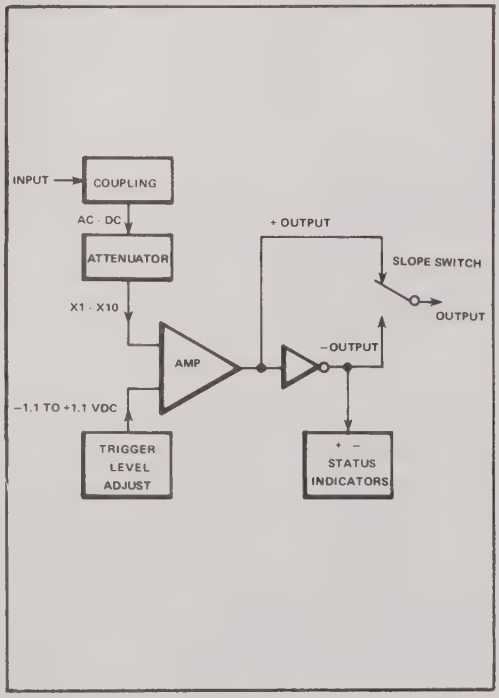


Figure 3-8 . INPUT AMPLIFIER, FUNCTIONAL BLOCK DIAGRAM .

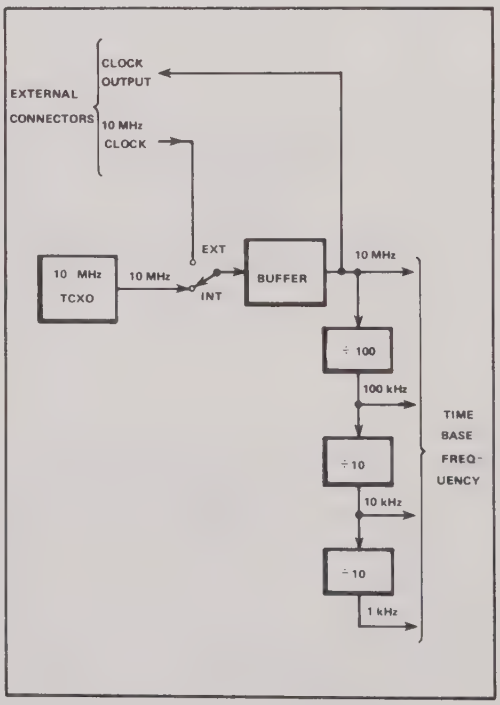


Figure 3-9 . TIME BASE GENERATOR, SIMPLIFIED BLOCK DIAGRAM .

differential amplifier. The high gain amplifier operates as an open loop voltage comparator. The comparators reference voltage is established by the Trigger Level Adjust whose output is continuously adjustable from + 1.1 to - 1.1 V dc. When the input voltage exceeds the reference voltage, the amplifier generates a leading or lagging edge output transition, depending on the position of the Slope Switch. One of the Status Indicators is normally illuminated to indicate the polarity of the input required to produce an output. The illumination pattern is reversed when an output is generated.

3-34 Time Base Generator

3-35 The Time Base Generator, as shown in Figure 3-9, consists of a 10 MHz Crystal Oscillator, a buffer and four BCD counters. The function of the Time Base Generator is to generate four separate output frequencies (10 MHz, 100 kHz, 10 kHz and 1 kHz) using a standard 10 MHz frequency source to the Buffer input. The Buffer, equipped with input overvoltage protection, converts the 10 MHz input signal to a buffered, TTL compatible output. The 100 kHz, 10 kHz and 1 kHz outputs are derived from the 10 MHz output using decade counters operated in series.

3-36 Time Base Divider

3-37 The Time Base Divider, as shown in Figure 3-10, consists of five BCD counters which are connected in series to provide six separate output frequencies. Each frequency is a power of 10 multiple of the Reference Frequency and can be selected for use as an Output Period signal by properly positioning the RANGE switch.

3-38 Display Counter

3-39 The Display Counter, as shown in Figure 3-11, consists of four flip-flops, one LED

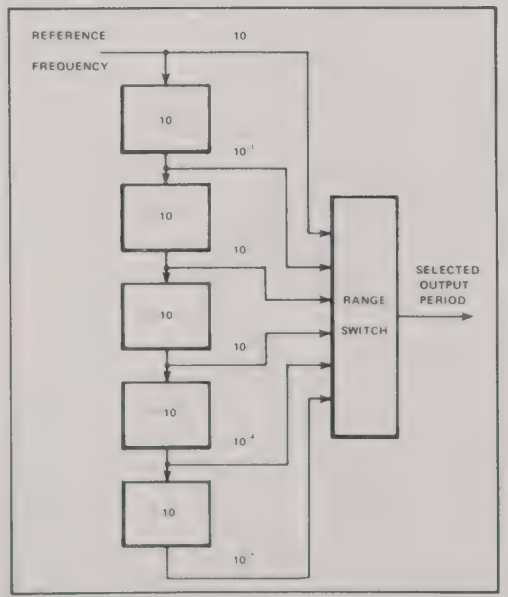


Figure 3-10 . TIME BASE DIVIDER, SIMPLIFIED BLOCK DIAGRAM .

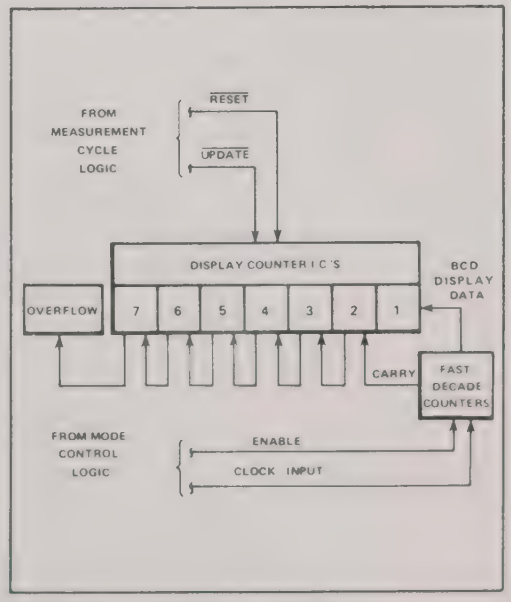


Figure 3-11 . DISPLAY COUNTER, SIMPLIFIED BLOCK DIAGRAM .

and seven Display-Counter (Numeric Display with Logic) IC's. The function of the Display Counter is to totalize, store and display each Clock Input pulse which occurs while the Enable signal is at a logic 1. In operation, seven Display Counter IC's are cascaded to form a seven decade counter. Since the least significant counter decade must be capable of operating at an 80 MHz rate, the counter section of that decade is replaced with a Fast Decade Counter which consists of four separate flip-flops. The Carry output of the Fast Decade Counter is used as a clock input for the second least significant decade while the BCD output of the Fast Decade Counter is used as display data for the least significant decade.

3-40 When the Enable input is at a logic 1, the Clock Input signal is totalized but the accumulated total is not displayed until an Update command (logic 0) is received. The Update command enables a latch in each Display Counter IC to store the output of the associated counter. The data in the latch is displayed as a numeric digit and will continue to be displayed after the Update command is removed. The counters are cleared to zero using the Reset command. Sequentially commanding the Reset and Update commands causes both the counter and display to be set to zero.

3-41 Measurement Cycle Logic

3-42 The Measurement Cycle Logic, as shown in Figure 3-12, consists of a flip-flop, one BCD counter, a one of 10 decoder and an adjustable one-shot. The function of the Measurement Cycle Logic is to interlock and control the actions of both the measurement cycle and the subsequent transfer of accumulated measurement data to the Display Counter readouts. In operation, the BCD counter is initially setting at a count of four indicating that a measurement cycle has been completed and that a Reset command is required to initiate a new measurement. The Reset command can be generated using the manual RESET switch. The manual Reset command resets the counter to zero while the cycle rate one-shot (when timed out) enables the counter to sequence through to the count of nine. The nine count is fedback to the flip-flop and the count sequence is again inhibited. In either event, the reset action initiates a new measurement cycle and causes the BCD counter to be reset to zero by the EOM command. The EOM command remains low for the duration of the measurement cycle and returns to the high state to indicate that the cycle is complete. When the Measurement Cycle is complete, the counter is enabled and advanced by the 500 Hz clock generated by the flip-flop. As count number one is decoded, the Update pulse is generated to transfer accumulated data to the display readout. Count number two is used to trigger the one-shot if the INT - EXT switch is in the INT position. Count number four returns the Measurement Cycle Logic to the initial position. Notice that when the one-shot is used to restart the counter, count number seven is used to generate the Reset pulse.

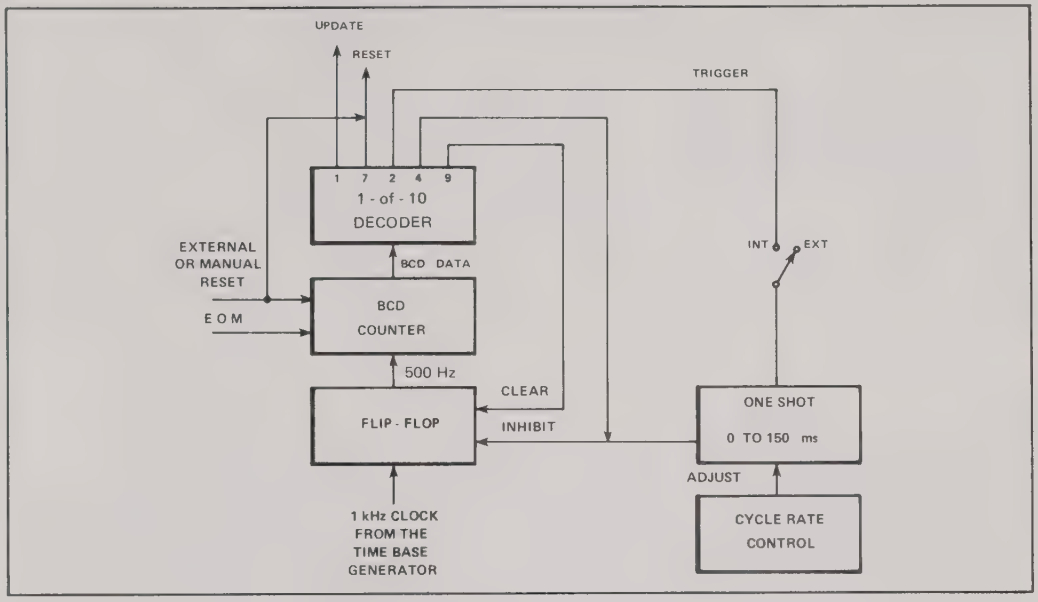


Figure 3-12 . MEASUREMENT CYCLE LOGIC,
SIMPLIFIED BLOCK DIAGRAM .

Section 4
Maintenance

4-1 INTRODUCTION

4-2 This section of the manual contains maintenance information for the Model 1952B. This includes service information, general maintenance, performance test, calibration and troubleshooting. The performance test is recommended as a preventative maintenance tool and should be executed every 90 days to verify proper instrument operation. Troubleshooting information is given in the form of flowcharts at the end of this section. Table 4-1 lists the recommended test equipment required for the performance test and troubleshooting.

Table 4-1 EQUIPMENT REQUIRED FOR PERFORMANCE TEST AND TROUBLESHOOTING

EQUIPMENT TYPE	REQUIRED BASIC SPECIFICATIONS	WHERE USED
Quartz oscillator frequency standard with 10 or 1 & 5 or 50 MHz output	Short term stability to be better than 1×10^{-8} Long term stability to be better than 1×10^{-9} @ 0 - 50°C ambient temperatures	Time Base Oscillator Adjustment
Low Frequency Oscillator	Frequency Range: DC - 10 MHz; Variably attenuated output from 1 mV rms to 1 V or 5 V rms @ 50 ohms output impedance; selectable sinewave and square wave modes;	Performance Check; Calibration
High Frequency Oscillator	Frequency Range: 10 MHz - 100 MHz Variably attenuated calibrated output from 1 mV to 1 V or 5 V rms (50 ohms output impedance); CW mode	Performance Check; Calibration

EQUIPMENT TYPE	REQUIRED BASIC SPECIFICATIONS	WHERE USED
RF Millivoltmeter	Frequency Range: 10 kHz - 100 MHz; Voltage Range: 1 mV - 5 V rms Accuracy: Maximum 3% of reading @ 100 MHz + 1% full scale VSWR: Less than 1:1.15 Power Sensitivity: 200 pW @ 50 ohms Basic Accessories: 50 ohms BNC Adapter;	Peformance Check; Calibration
Multimeter	Capable of measuring DC & AC voltage: DC & AC current; Resistance DC VOLTAGE RANGE of ± 199.9 mV to ± 1999 V with accuracy better than ± 1% of reading AC VOLTAGE RANGE of 199.9 mV to 1999 V with accuracy better than ± 1.5% of reading DIRECT CURRENT RANGE of ± 199.9 uA to ± 1999 mA with accuracy better than ± 1% of reading ALTERNATING CURRENT RANGE of 199.9 uA to 1999 mA with accuracy better than ± 1.5% of reading RESISTANCE RANGE of 199.9 ohms to 19.99 M ohm with accuracy better than ± 1% of reading	Troubleshooting
Oscilloscope	DUAL TRACE; 100 MHz BANDWIDTH 2 mV per division sensitivity; TIME BASE @ 0.05 us/div. with time delay features	Troubleshooting

4-3 SERVICE INFORMATION

4-4 Each instrument that is manufactured by the John Fluke Mfg. Co., Inc. is warranted for a period of one year upon delivery to the original purchaser. The WARRANTY is given on the back of the title page located in the front of this manual.

4-5 Factory authorized calibration and service for each Fluke product is available at various world wide locations. A complete list of these service centers is included with the WARRANTY. Shipping information is given in the operating instructions section of this manual. If requested, an estimate will be provided to the customer before work is begun on instruments that are beyond the warranty period.

4-6 GENERAL MAINTENANCE

4-7 Access Information

4-8 All PCB assemblies used in the Model 1952B can be accessed for maintenance purposes by removing the top and bottom dust covers from the instrument. Four phillips head screws hold each dust cover in place. Once the top dust cover is removed, the Display-Counter PCB and Switch assemblies can be removed using the procedures outlined in the following paragraphs.

4-9 DISPLAY COUNTER PCB ASSEMBLY

4-10 Use the following procedure to remove the Display Counter PCB Assembly from the 1952B.

a. Remove the top and bottom dust covers.

b. Remove the knobs from all front panel controls.

c. Remove the front panel nuts from the FUNCTION, RANGE and RESET switches.

d. Remove the two screws located on both side brackets close to the front panel.

e. Turn the instrument over and unsolder the connections to the CHANNEL A and B, BNC connectors.

f. Unsolder the two wires at the rear of the CYCLE RATE control.

g. Using a rocking motion pull the front panel free of the chassis.

h. Locate and remove the four screws holding the Display Counter PCB Assembly to the front panel.

i. Install the Display Counter PCB Assembly by logically reversing this procedure.

4-11 SWITCH PCB ASSEMBLY

4-12 Use the following procedure to remove the Switch PCB Assembly from the 1952B.

a. Complete steps a. through h. of the procedure given for removing the Display Counter PCB Assembly.

b. Pull the Switch PCB Assembly out of the card edge connector.

c. Install the Switch PCB Assembly by logically reversing this procedure.

4-13 Cleaning

4-14 Clean the Model 1952B periodically to remove dust, grease and other contamination. Use the following procedure:

a. Clean the surface of all PCB's using clean dry air at low pressure (< 120 PSI). If grease is encountered, spray with Freon T.F. Degreaser and remove grime with clean dry air at low pressure.

b. Clean the front panel with a soft cloth dampened with a mild solution of detergent and water.

4-15 Fuse Replacement

4-16 The power fuse F1 is located on the rear panel of the Model 1952B. If replacement is necessary, use the following rated fuses:

a. 1 Amp slo-blo for 115 V ac

b. 1/2 Amp slo-blo for 230 V ac

4-17 Service Tools

4-18 No special tools are required to maintain or repair the Model 1952B Counter/Timer.

4-19 PERFORMANCE TEST

The performance test is designed to verify the overall operation of the Model 1952B. This test can be used as an acceptance check and/or periodic maintenance check. Table 4-1 lists the equipment required to perform this test. If the counter fails any part of the performance test, corrective action is indicated. Troubleshooting information for fault isolation is given later in this section.

4-20 Set-Up Procedure

4-21 Prior to executing the performance test complete the following set-up procedure:

a. Connect the Model 1952B to line power.

b. Rotate the CYCLE RATE control out of the POWER OFF detent and set to the maximum CW position. The front panel display should illuminate.

c. Set the rear panel EXT-INT switch to the INT position.

d. Set the CONT-TRIG switch to the CONT position.

e. Set the CHANNEL A and B Trigger Level Controls to the following positions:

1. Trigger Level Adjust to maximum counter clockwise, PRESET.

2. Slope switch to + (positive).

3. Coupling switch to AC.

4. Attenuator switch to X1.

4-22 Channel A Amplifier Test

4-23 Use the following procedure to test the CHANNEL A Amplifier and Trigger Level Controls:

a. Complete the Set-Up Procedure.

b. Connect a 2 V rms, 1 kHz signal source to CHANNEL A input connector.

c. Observe the CHANNEL A Status Indicators. Both should be illuminated.

d. Change the settings of the Slope, Coupling and Attenuator switches associated with CHANNEL A. The Status Indicators should both remain on.

e. Set the Attenuator switch to the X10 position and the Coupling switch to the AC position.

f. Move the Trigger Level Adjust just out of the Preset detent. The + Status Indicator should be on and the - indicator should be off.

g. Move the Trigger Level Adjust CW to the center of its travel. Both Status Indicators should be lit.

h. Move the Trigger Level Adjust to the maximum CW position. The - Status Indicator should be on the + indicator should be off.

4-24 Channel B Amplifier Test

4-25 Test the CHANNEL B amplifier using the general procedure given in the previous paragraph for testing the CHANNEL A amplifier. Substitute CHANNEL B in all cases where CHANNEL A is mentioned.

4-26 Display Test

4-27 Test the front panel display using the following procedure:

a. Complete the Set-Up Procedure.

b. Refer to Table 4-2 and sequentially select each of the RANGE switch settings for each setting of the FUNCTION switch. As each range is selected ensure that the numeric readout, decimal point location and measurement units are correctly displayed.

c. Set the FUNCTION switch to the A GTD.BY B position.

d. Connect a 1 V rms, 5 Hz signal source to the CHANNEL A Input Connector.

e. Set the CHANNEL A Coupling switch to DC.

f. Rotate the CHANNEL B Trigger Level Adjust CW out of the preset position until the display begins to accumulate the CHANNEL A input frequency. As each count is received, observe the least significant decade and ensure that each number is properly displayed.

g. Slowly increase the input frequency as necessary to check the operation of each decade. When all display decades reach a count of nine, the next input signal will overflow the counter and cause the display to read all zeros. In addition, an OVERFLOW LED is illuminated to indicate that the counter capability has been exceeded.

h. Press the RESET button. The display should reset to zero and the OVERFLOW indicator should be turned off. When the button is released the totalizing process starts over.

TABLE 4-2. RANGE DISPLAY INFORMATION FOR AVAILABLE FUNCTIONS

MODE	RANGE INDICATIONS	DISPLAY FOR AVAILABLE RANGE SETTINGS					
FREQ. A	GATE t DISPLAY MEAS. UNITS	0.1 ms .00 MHz	1.0 ms .000 MHz	10 ms .0000 MHz	0.1 s .00 kHz	1.0 s .000 kHz	10 s .0000 kHz
FREQ.(A/B)N	PER. AVGD. DISPLAY MEAS. UNITS	10^0 0 NONE	10^1 0 NONE	10^2 0 NONE	10^3 0 NONE	10^4 0 NONE	10^5 0 NONE
PERIOD A	PER. AVGD. DISPLAY MEAS. UNITS	10^0 .00 ms	10^1 .000 ms	10^2 .0000 ms	10^3 .00 us	10^4 .000 us	10^5 .0000 us
T.I. A-B	T.I. RES DISPLAY MEAS. UNITS	.1 us .0000 ms	1 us .000 ms	10 us .00 ms	0.1 ms .0000 s	1.0 ms .000 s	10 ms .00 s
A GTD.BY B	RANGE DISPLAY MEAS. UNITS	N/A NONE NONE	N/A NONE NONE	N/A NONE NONE	N/A NONE NONE	N/A NONE NONE	N/A NONE NONE
SELF CHECK	GATE t DISPLAY MEAS. UNITS	0.1 ms 10 NONE	1.0 ms 100 NONE	10 ms 1000 NONE	0.1 s 10000 NONE	1.0 s 100 000 NONE	10 s 1000 000 NONE

4-28 Frequency A Test

4-29 Test the Frequency A mode using the following procedure:

a. Complete the Set-Up Procedure.

b. Set the FUNCTION switch to the FREQ A position.

c. Connect a 1 V rms, 100 kHz signal source to the CHANNEL A Input Connector.

d. Set the RANGE switch to each of the GATE t positions listed in Table 4-3 and ensure the numeric and measurement units display are reading correctly.

Table 4-3. DISPLAY READOUT FOR FREQUENCY A TEST.

GATE t SETTING	NUMERIC READOUT*	MEASUREMENT UNITS
0.1 ms	.10	MHz
1.0 ms	.100	MHz
10 ms	.1000	MHz
0.1 s	100.00	kHz
1.0 s	100.000	kHz
10 s	100.0000	kHz

* The accuracy of the numeric readout is dependent on the frequency accuracy of the 100 kHz signal source.

4-30 Ratio Test

4-31 Test the Frequency (A/B)N ratio mode using the following procedure:

a. Complete the Set-Up Procedure.

b. Set the FUNCTION switch to the FREQ (A/B)N position.

c. Set the SEP - COM switch to the COM position.

d. Connect a 1 V rms, 100 kHz signal source to the CHANNEL A Input Connector.

e. Set the RANGE switch to each of the PER.AVGD (period averaged) positions listed in Table 4-4 and ensure that the display readout is correct for each position. Decimal point and measurement units information are not displayed in the ratio mode.

Table 4-4. DISPLAY READOUT FOR RATIO FUNCTION TEST.

PER AVGD. SETTING**	NUMERIC READOUT
10^0	1
10^1	10
10^2	100
10^3	1000
10^4	10000
10^5	100000

** A ratio of 1 is indicated in all cases. The decimal point is determined by starting at the right of the readout

counting to the left the number of places indicated by the exponent for the PER.AVGD. setting.

4-32 Period A Test

4-33 Check the period A mode using the following procedure:

a. Complete the Set-Up Procedure.

b. Set the FUNCTION switch to the FREQ A position.

c. Connect a 1 V rms, 10 kHz signal source to the CHANNEL A Input Connector.

d. Set the RANGE switch to the 10 s position and adjust the signal source to produce a display of 10.0000 kHz on the 1952B.

e. Set the FUNCTION switch to the PERIOD A position.

f. Set the RANGE switch to each of the PER.AVGD. positions listed in Table 4-5 and ensure that the display readout is correct for each position.

Table 4-5. DISPLAY READOUTS FOR PERIOD A TEST

PER.AVGD. SETTINGS	NUMERIC READOUT*	MEASUREMENT UNITS
10^0	.10	ms
10^1	.100	ms
10^2	.1000	ms
10^3	100.00	us
10^4	100.000	us
10^5	100.0000	us

* The accuracy of the readout is dependent on the frequency accuracy of the 10 kHz signal source.

4-34 Time Interval Test

4-35 Test the time interval mode using the following procedure:

a. Complete the Set-Up Procedure.

b. Set the FUNCTION switch to the FREQ A position.

c. Connect a 1 V rms, 100 Hz signal source to the CHANNEL A Input Connector.

d. Set the RANGE switch to the 10 s position and adjust the signal source to produce a display of 0.1000 kHz on the 1952B.

e. Set the FUNCTION switch to the T.I. A-B position.

f. Set the SEP - COM switch to the COM position.

g. Set the RANGE switch to each of the T.I. RES. (time interval resolution) positions listed in Table 4-6 and ensure that the display readout is correct for each position.

Table 4-6. DISPLAY READOUTS FOR TIME INTERVAL TEST

T.I. RES SETTING	NUMERIC READOUT*	MEASUREMENT UNITS
0.1 us	10.0000	ms
1.0 us	10.000	ms
10 us	10.00	ms
0.1 ms	.0100	s
1.0 ms	.010	s
10 ms	.01	s

* The accuracy of the readout is dependent on the frequency accuracy of the 100 Hz signal source.

4-36 Totalize Test

4-37 Test the totalize mode (A gated by B) using the following procedure:

a. Complete the Set-Up Procedure.

b. Set the FUNCTION switch to the A GTD BY B position.

c. Connect a 1 V rms, 100 Hz signal source to the CHANNEL A Input Connector.

d. Rotate the CHANNEL B Trigger Level Adjust out of the detent position until the -(minus) Status Indicator is illuminated.

e. Press the RESET button. The display should return to 0 (zero). Decimal point and measurement units are not displayed.

f. Rotate the CHANNEL B Trigger Level Adjust until the + (plus) Status Indicator is illuminated. The counter should begin to accumulate and display the 100 Hz input frequency present on the CHANNEL A Input Connector.

g. Rotate the CHANNEL B Trigger Level Adjust until the - Status Indicator is illuminated. The counter should stop and display the accumulated total.

h. Repeat steps f. and g. above. The accumulation process should continue as long as the + Status Indicator is illuminated. Notices that as steps f. and g. are repeated the displayed total is not reset. Instead, new inputs are added to the previous total.

4-38 Self Check Test

4-39 Test the self check mode using the following Procedure:

a. Complete the Set-Up Procedure.

b. Set the FUNCTION switch to the SELF CHECK position.

c. Set the RANGE switch to each of the GATE t positions listed in Table 4-7 and ensure that the display readout is correct for each position. Decimal point and measurement units are not displayed.

Table 4-7. DISPLAY READOUT FOR SELF CHECK TEST

GATE t SETTINGS	NUMERIC READOUT
0.1 ms	10
1.0 ms	100
10 ms	1000
0.1 s	10000
1.0 s	100000
10 s	1000000

4-40 CALIBRATION

4-41 The Model 1952B should be calibrated every 90 days or whenever repairs have been made. Calibration should be done at an ambient room temperature of $25^{o}C \pm 5^{o}C$. Table 4-1 lists the required equipment.

4-42 Trigger Level Preset Adjust

4-43 Use the following procedure to calibrate the CHANNEL A and B preset trigger levels:

a. Remove the top dust cover from the Model 1952B.

b. Connect the 1952B to line power.

c. Turn-on the 1952B using the CYCLE RATE switch.

d. Set the CHANNEL A and B Attenuator switches to the X10 position.

e. Turn the CHANNEL A and B Trigger Level Controls to the maximum counter-clockwise position (PRESET).

f. Locate the potentiometer directly behind the CHANNEL A Trigger Level Adjust on the main PCB Assembly.

g. Using a suitable screw driver, rotate the potentiometer until the CHANNEL A -(negative) Status indicator is illuminated. Reverse direction, and slowly turn the pot until the + (positive) Status Indicator just turns-on.

h. Click the CHANNEL A Trigger Level Adjust in and out of the PRESET detent. The + Status indicator should always illuminate in the preset detent.

i. Locate the potentiometer directly behind the CHANNEL B Trigger Level Adjust on the main PCB Assembly.

j. Calibrate the CHANNEL B preset trigger level using the procedures given in steps g. and h. above. Substitute CHANNEL B where CHANNEL A is mentioned.

4-44 Timebase Adjust

4-45 Calibrate the 10 MHz timebase oscillator using the following procedure:

a. Remove the top dust cover from the Model 1952B.

b. Connect the 1952B to line power.

c. Turn-on the 1952B using the POWER/CYCLE RATE switch.

d. Set the FUNCTION switch to the FREQ A position.

e. Set the CONT - TRIG switch to the CONT position.

f. Connect the 1 MHz frequency standard to the CHANNEL A Input Connector.

g. Adjust the CHANNEL A trigger level controls to establish the desired trigger condition. Proper triggering occurs when the + and - Status Indicators are both illuminated.

h. Set the RANGE switch to the 10 s GATE t position.

i. Press and release the RESET switch. After ten seconds the 1952B should display a count of 000.0000 Hz and the OVERFLOW LED should be illuminated.

j. If the display is incorrect, locate the TIMEBASE adjustment at the BOTTOM rear of the Main Board PCB Assembly, and using an insulated tuning tool, adjust the oscillator tuning screw.

k. Repeat steps i. and j. of this procedure until the proper display is obtained.

4-46 TROUBLESHOOTING

4-47 The following information is designed to aid in troubleshooting the Model 1952B. Fault isolation is achieved by executing the performance test and isolating the problem to a functional logic group using troubleshooting flowcharts. The flowchart symbols are defined in Figure 4-1 and the troubleshooting flowcharts are given in Figure 4-2.

Figure 4-1. TROUBLESHOOTING FLOWCHART SYMBOLS

INTERCONNECTS FLOWCHART SYMBOLS AND INDICATES THE DIRECTION OF PROCEDURE FLOW.

START

A TERMINAL POINT - USED TO INDICATE A START, STOP OR INTERRUPT OF PROCEDURE FLOW.

MEASURE DC VOLTAGE ACROSS CAPACITOR C 1

INSTRUCTION OR PROCEDURAL STEP.

+12 TO +13 VDC ?

DECISION REQUIRED - ALWAYS ASK A QUESTION - THE FLOW FROM THE SYMBOL IS DEPENDENT UPON THE DECISION MADE - USUALLY YES (GO) OR NO (NO GO), BUT MAY HAVE THREE POSSIBILITIES (eg. HIGH, LOW, NORMAL).

SEE FIGURE 2 FOR THE LOCATION OF THE +5 VDC ADJUSTMENT, R8

ANNOTATION - PROVIDES ADDITIONAL INFORMATION FOR THE SYMBOL TO WHICH IT IS CONNECTED. ALWAYS CONNECTED BY A DASHED LINE.

101

CONNECTOR - EXIT TO, OR ENTRY FROM, ANOTHER PART OF THE FLOWCHART (ASSOCIATED ARROWHEAD SHOWS WHICH).

PERFORM REGULATION TEST

PREDEFINED PROCESS - INDICATES THAT THE PROCEDURE TO BE PERFORMED IS DESCRIBED ELSEWHERE.

Figure 4-2. TROUBLESHOOTING FLOWCHART (Sheet 1 of 6)

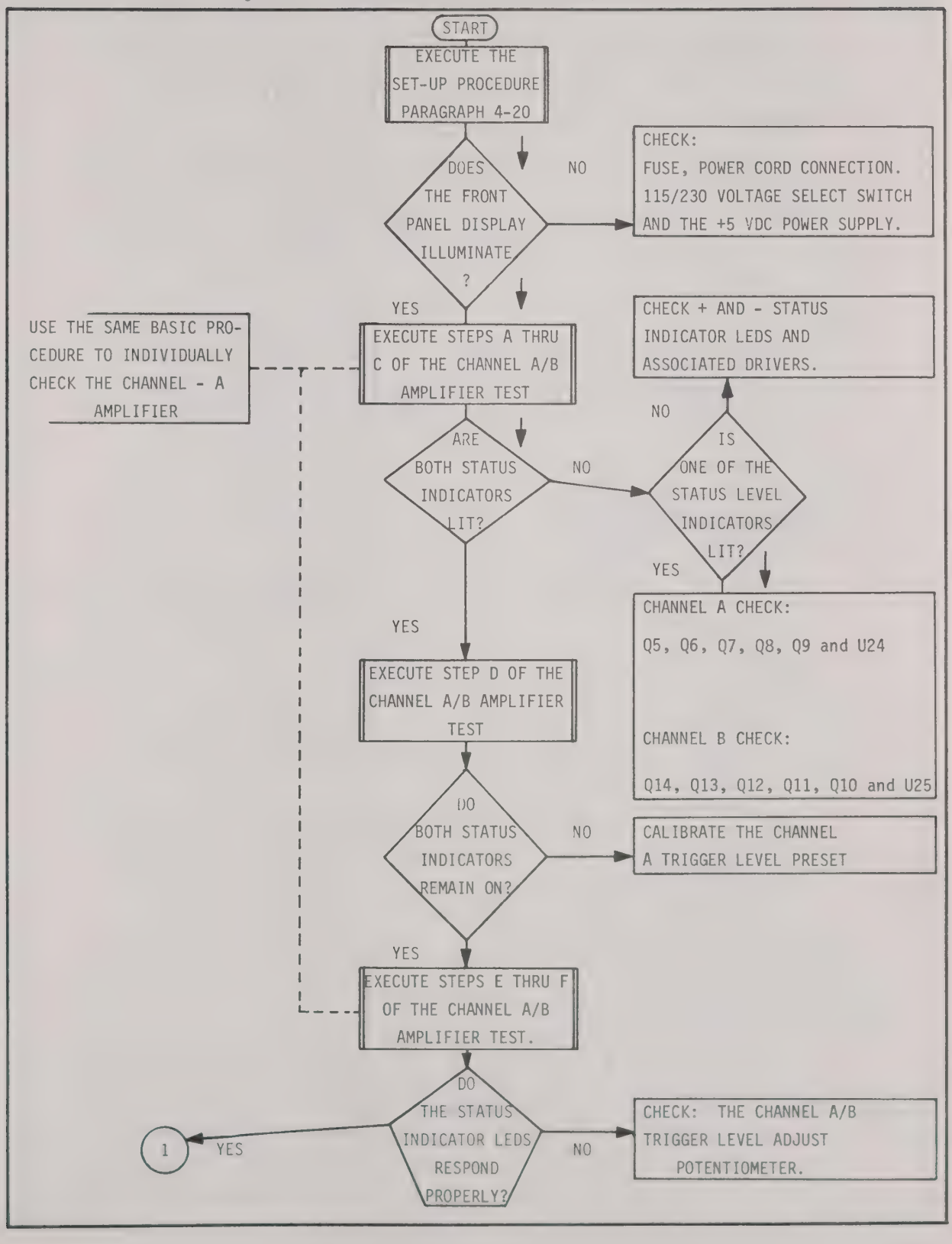

START
EXECUTE THE SET-UP PROCEDURE PARAGRAPH 4-20
DOES THE FRONT PANEL DISPLAY ILLUMINATE ?
NO
CHECK: FUSE, POWER CORD CONNECTION. 115/230 VOLTAGE SELECT SWITCH AND THE +5 VDC POWER SUPPLY.
YES
USE THE SAME BASIC PROCEDURE TO INDIVIDUALLY CHECK THE CHANNEL - A AMPLIFIER
EXECUTE STEPS A THRU C OF THE CHANNEL A/B AMPLIFIER TEST
CHECK + AND - STATUS INDICATOR LEDS AND ASSOCIATED DRIVERS.
NO
ARE BOTH STATUS INDICATORS LIT?
NO
IS ONE OF THE STATUS LEVEL INDICATORS LIT?
YES
CHANNEL A CHECK:
Q5, Q6, Q7, Q8, Q9 and U24
CHANNEL B CHECK:
Q14, Q13, Q12, Q11, Q10 and U25
YES
EXECUTE STEP D OF THE CHANNEL A/B AMPLIFIER TEST
DO BOTH STATUS INDICATORS REMAIN ON?
NO
CALIBRATE THE CHANNEL A TRIGGER LEVEL PRESET
YES
EXECUTE STEPS E THRU F OF THE CHANNEL A/B AMPLIFIER TEST.
DO THE STATUS INDICATOR LEDS RESPOND PROPERLY?
1
YES
NO
CHECK: THE CHANNEL A/B TRIGGER LEVEL ADJUST POTENTIOMETER.

Figure 4-2. TROUBLESHOOTING FLOWCHART (Sheet 2 of 6)

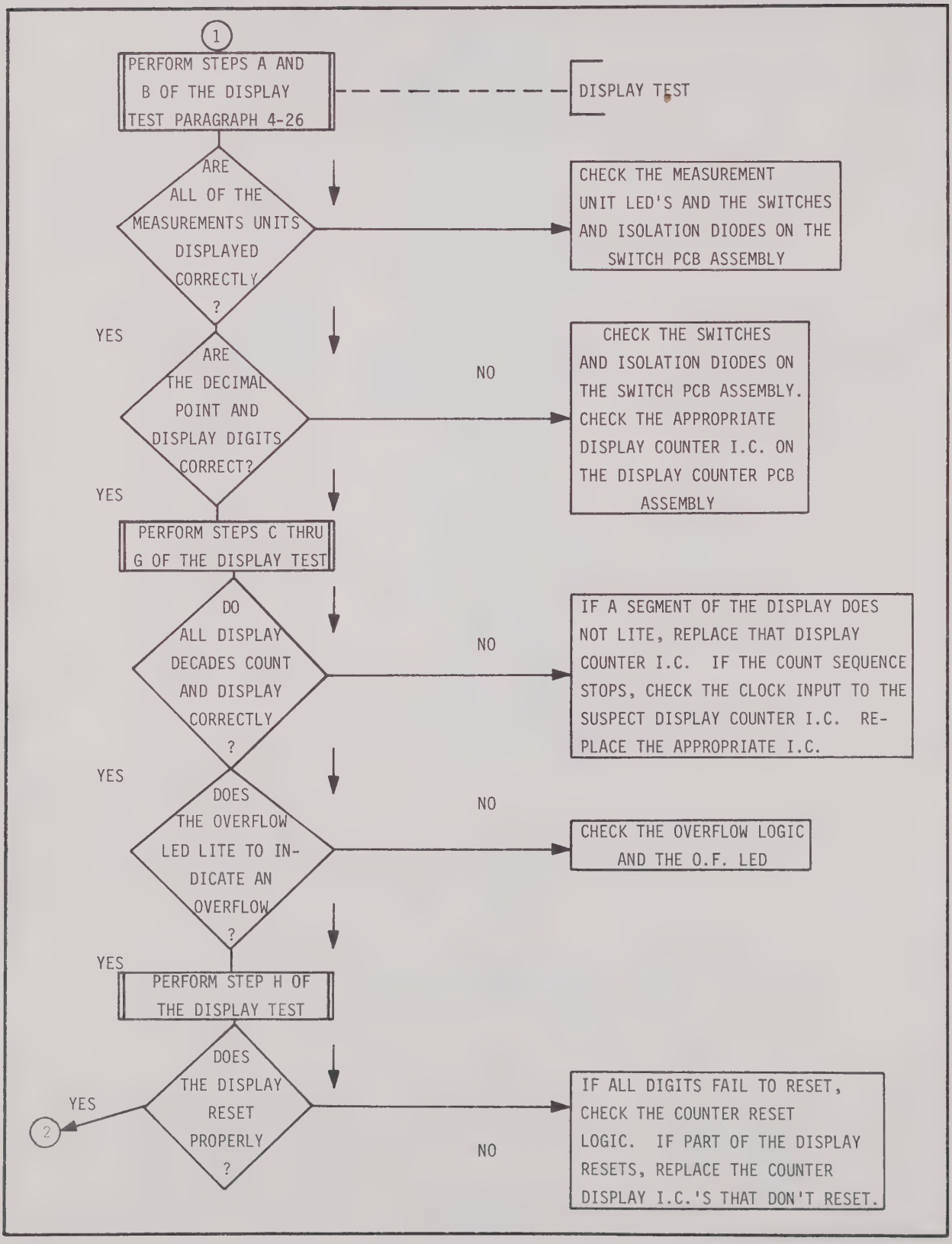

1
PERFORM STEPS A AND B OF THE DISPLAY TEST PARAGRAPH 4-26
DISPLAY TEST
ARE ALL OF THE MEASUREMENTS UNITS DISPLAYED CORRECTLY ?
CHECK THE MEASUREMENT UNIT LED'S AND THE SWITCHES AND ISOLATION DIODES ON THE SWITCH PCB ASSEMBLY
YES
ARE THE DECIMAL POINT AND DISPLAY DIGITS CORRECT?
NO
CHECK THE SWITCHES AND ISOLATION DIODES ON THE SWITCH PCB ASSEMBLY. CHECK THE APPROPRIATE DISPLAY COUNTER I.C. ON THE DISPLAY COUNTER PCB ASSEMBLY
YES
PERFORM STEPS C THRU G OF THE DISPLAY TEST
DO ALL DISPLAY DECADES COUNT AND DISPLAY CORRECTLY ?
NO
IF A SEGMENT OF THE DISPLAY DOES NOT LITE, REPLACE THAT DISPLAY COUNTER I.C. IF THE COUNT SEQUENCE STOPS, CHECK THE CLOCK INPUT TO THE SUSPECT DISPLAY COUNTER I.C. REPLACE THE APPROPRIATE I.C.
YES
DOES THE OVERFLOW LED LITE TO INDICATE AN OVERFLOW ?
NO
CHECK THE OVERFLOW LOGIC AND THE O.F. LED
YES
PERFORM STEP H OF THE DISPLAY TEST
DOES THE DISPLAY RESET PROPERLY ?
YES
2
NO
IF ALL DIGITS FAIL TO RESET, CHECK THE COUNTER RESET LOGIC. IF PART OF THE DISPLAY RESETS, REPLACE THE COUNTER DISPLAY I.C.'S THAT DON'T RESET.

Figure 4-2. TROUBLESHOOTING FLOWCHART (Sheet 3 of 6)

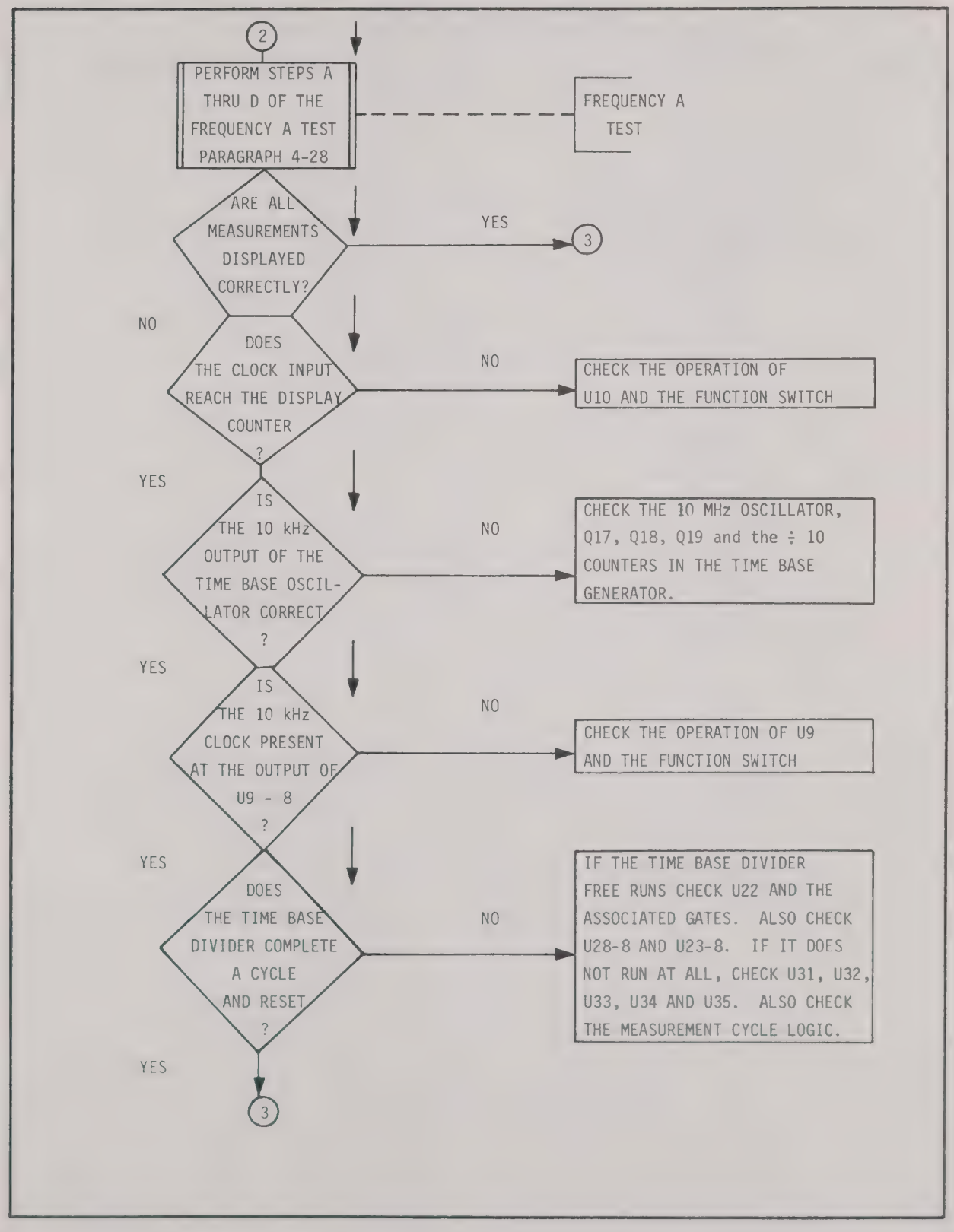

2
PERFORM STEPS A THRU D OF THE FREQUENCY A TEST PARAGRAPH 4-28
FREQUENCY A TEST
ARE ALL MEASUREMENTS DISPLAYED CORRECTLY?
YES
3
NO
DOES THE CLOCK INPUT REACH THE DISPLAY COUNTER ?
NO
CHECK THE OPERATION OF U10 AND THE FUNCTION SWITCH
YES
IS THE 10 kHz OUTPUT OF THE TIME BASE OSCILLATOR CORRECT ?
NO
CHECK THE 10 MHz OSCILLATOR, Q17, Q18, Q19 and the ÷ 10 COUNTERS IN THE TIME BASE GENERATOR.
YES
IS THE 10 kHz CLOCK PRESENT AT THE OUTPUT OF U9 - 8 ?
NO
CHECK THE OPERATION OF U9 AND THE FUNCTION SWITCH
YES
DOES THE TIME BASE DIVIDER COMPLETE A CYCLE AND RESET ?
NO
IF THE TIME BASE DIVIDER FREE RUNS CHECK U22 AND THE ASSOCIATED GATES. ALSO CHECK U28-8 AND U23-8. IF IT DOES NOT RUN AT ALL, CHECK U31, U32, U33, U34 AND U35. ALSO CHECK THE MEASUREMENT CYCLE LOGIC.
YES
3

Figure 4-2. TROUBLESHOOTING FLOWCHARTS (Sheet 4 of 6)

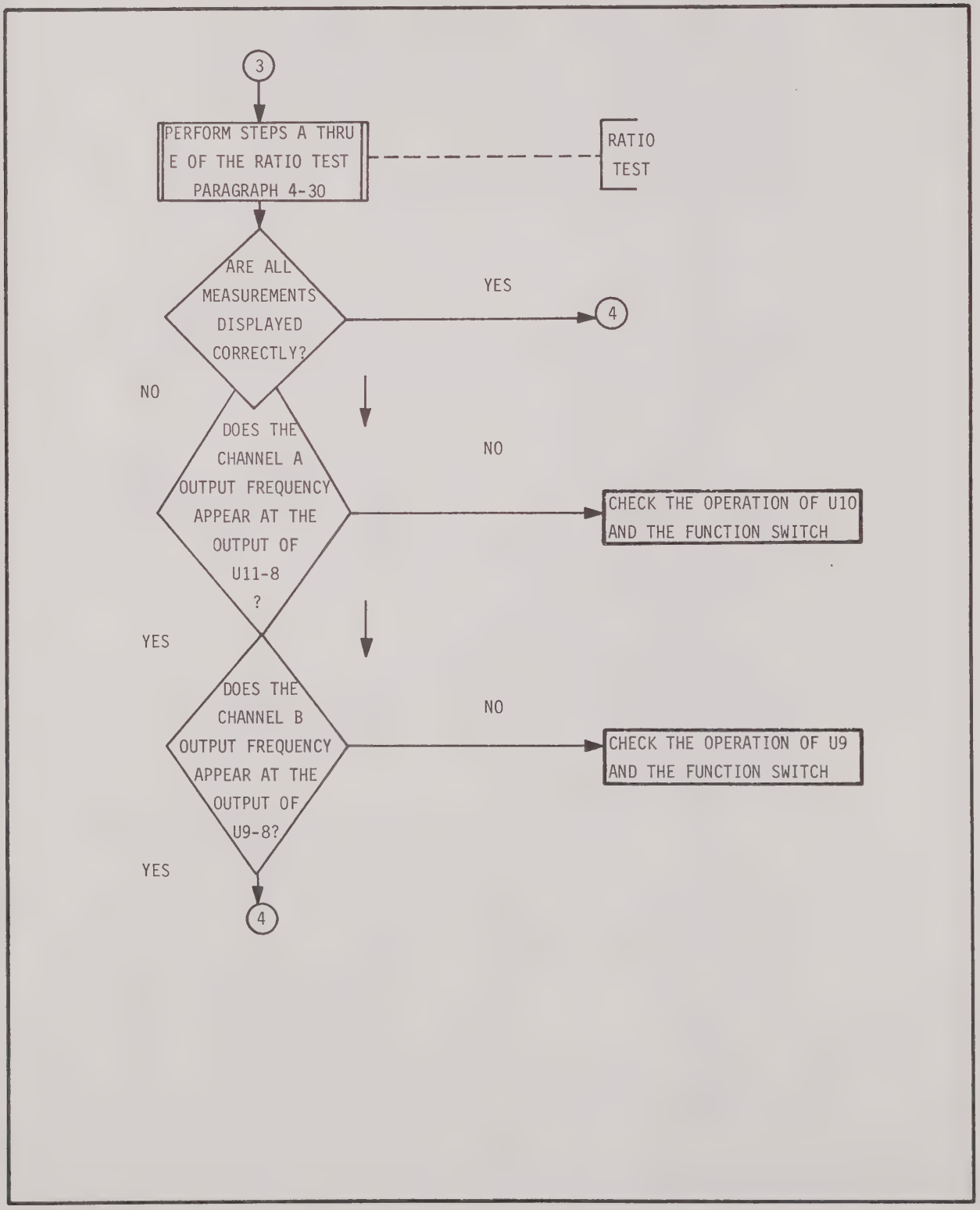

3
PERFORM STEPS A THRU E OF THE RATIO TEST PARAGRAPH 4-30
RATIO TEST
ARE ALL MEASUREMENTS DISPLAYED CORRECTLY?
YES
4
NO
DOES THE CHANNEL A OUTPUT FREQUENCY APPEAR AT THE OUTPUT OF U11-8 ?
NO
CHECK THE OPERATION OF U10 AND THE FUNCTION SWITCH
YES
DOES THE CHANNEL B OUTPUT FREQUENCY APPEAR AT THE OUTPUT OF U9-8?
NO
CHECK THE OPERATION OF U9 AND THE FUNCTION SWITCH
YES
4

Figure 4-2. TROUBLESHOOTING FLOWCHARTS (Sheet 5 of 6)

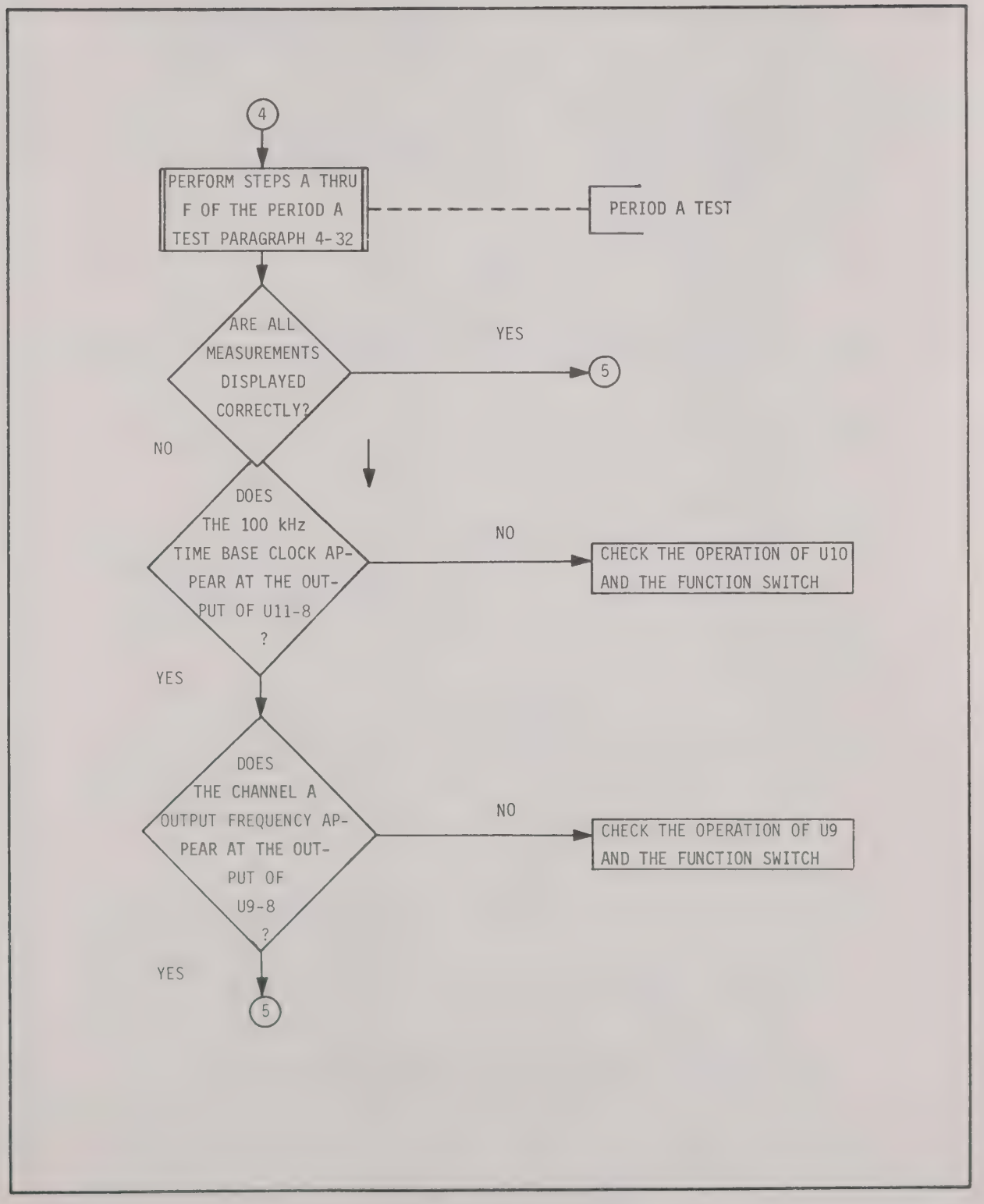
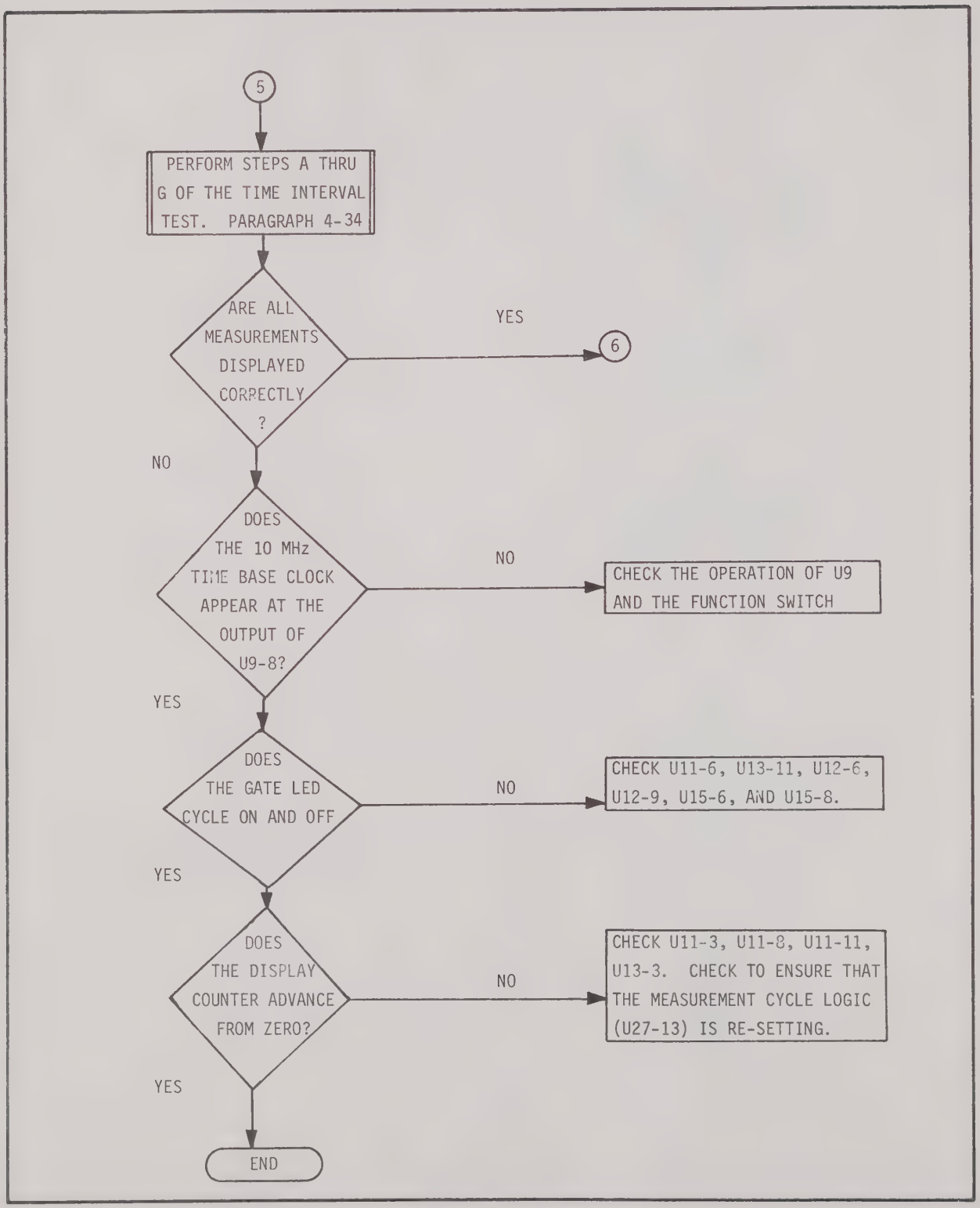

4
PERFORM STEPS A THRU F OF THE PERIOD A TEST PARAGRAPH 4-32
PERIOD A TEST
ARE ALL MEASUREMENTS DISPLAYED CORRECTLY?
YES
5
NO
DOES THE 100 kHz TIME BASE CLOCK APPEAR AT THE OUTPUT OF U11-8 ?
NO
CHECK THE OPERATION OF U10 AND THE FUNCTION SWITCH
YES
DOES THE CHANNEL A OUTPUT FREQUENCY APPEAR AT THE OUTPUT OF U9-8 ?
NO
CHECK THE OPERATION OF U9 AND THE FUNCTION SWITCH
YES
5

Figure 4-2. TROUBLESHOOTING FLOWCHARTS (Sheet 6 of 6)


5
PERFORM STEPS A THRU G OF THE TIME INTERVAL TEST. PARAGRAPH 4-34
ARE ALL MEASUREMENTS DISPLAYED CORRECTLY ?
YES
6
NO
DOES THE 10 MHz TIME BASE CLOCK APPEAR AT THE OUTPUT OF U9-8?
NO
CHECK THE OPERATION OF U9 AND THE FUNCTION SWITCH
YES
DOES THE GATE LED CYCLE ON AND OFF
NO
CHECK U11-6, U13-11, U12-6, U12-9, U15-6, AND U15-8.
YES
DOES THE DISPLAY COUNTER ADVANCE FROM ZERO?
NO
CHECK U11-3, U11-8, U11-11, U13-3. CHECK TO ENSURE THAT THE MEASUREMENT CYCLE LOGIC (U27-13) IS RE-SETTING.
YES
END

Section 5

Lists of Replaceable Parts

TABLE OF CONTENTS

ASSEMBLY NAME	PAGE
Final Assembly, Model 1952B	5-2
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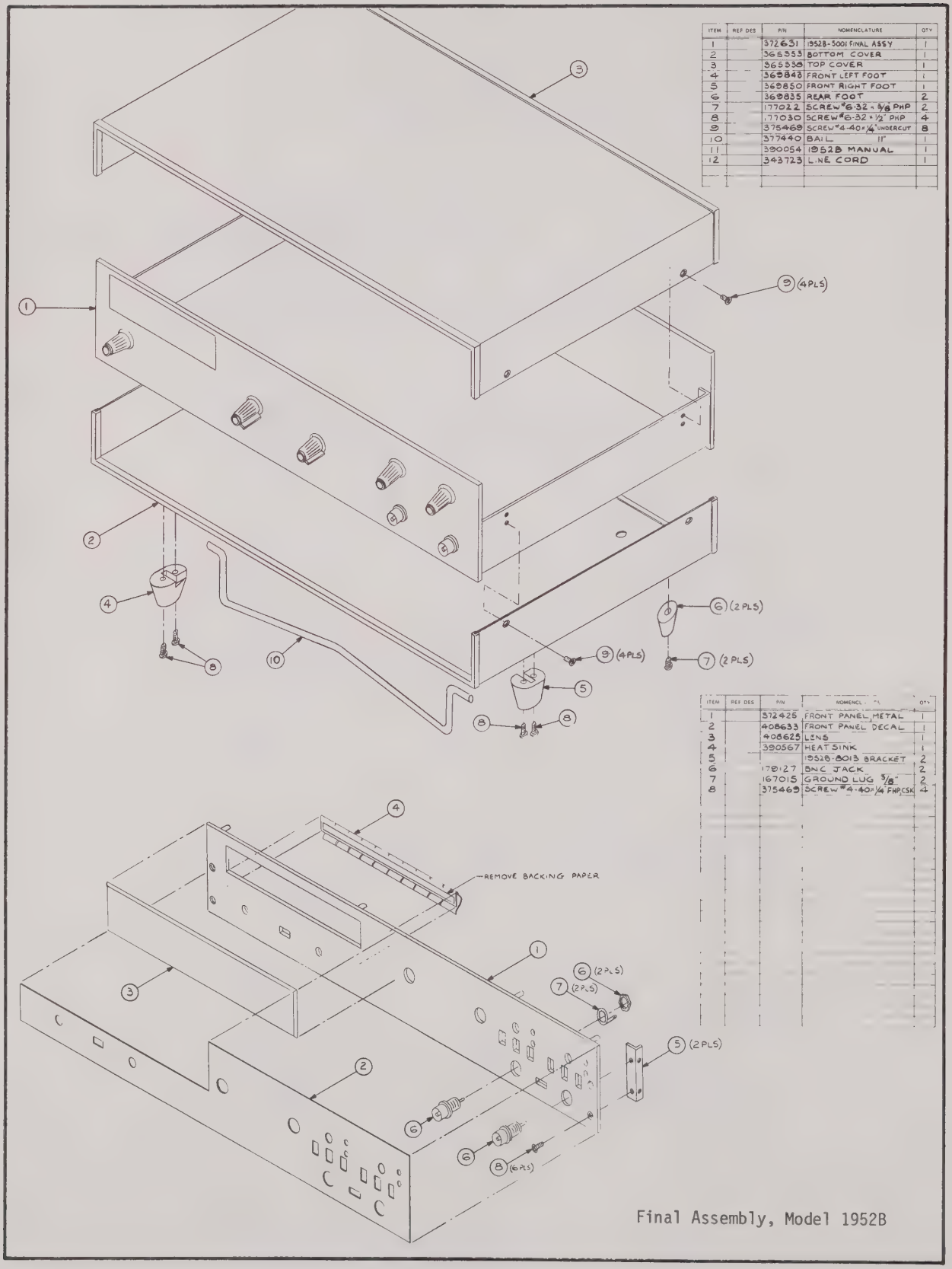
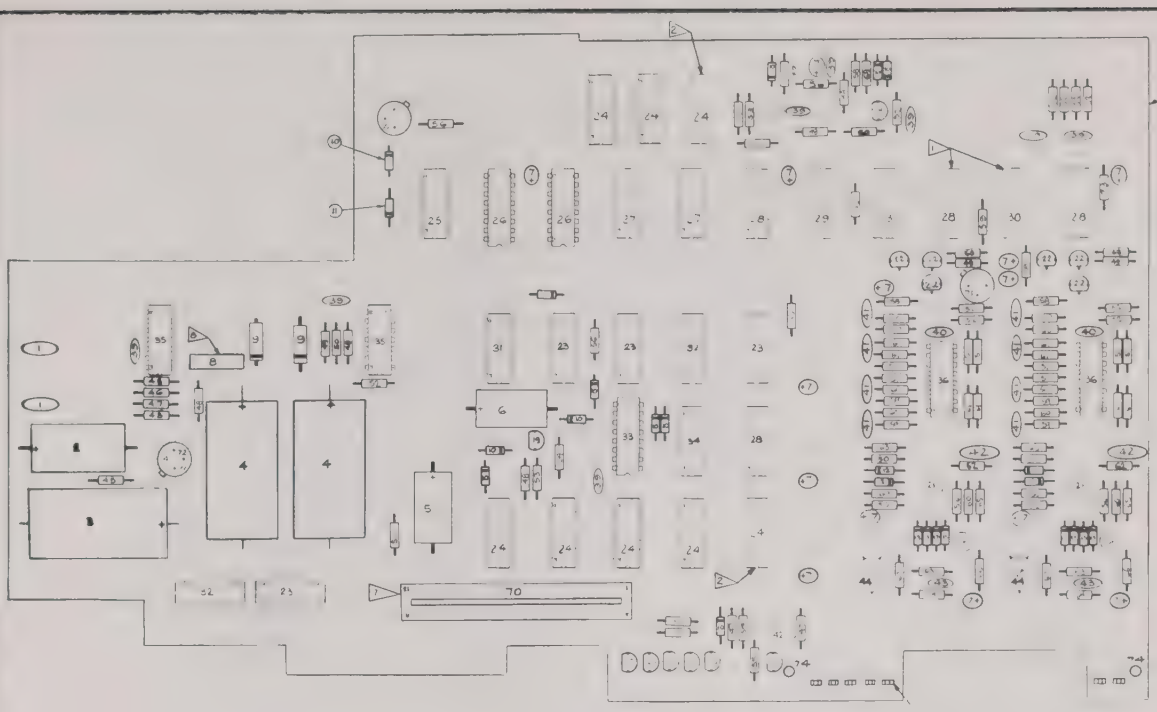
Display Board PCB Assembly	5-5
Input Board PCB Assembly	5-6
Switch Board PCB Assembly	5-7
Front Panel Assembly	5-8
Rear Panel Assembly	5-9


ITEM | REF DES | P/N | NOMENCLATURE | QTY
1 | | 372631 | 1952B-5001 FINAL ASSY | 1
2 | | 365353 | BOTTOM COVER | 1
3 | | 365338 | TOP COVER | 1
4 | | 365848 | FRONT LEFT FOOT | 1
5 | | 365850 | FRONT RIGHT FOOT | 1
6 | | 365835 | REAR FOOT | 2
7 | | 177022 | SCREW #6-32 x 3/8 PHP | 2
8 | | 177030 | SCREW #6-32 x 1/2 PHP | 4
9 | | 375469 | SCREW #4-40 x 1/4 UNDERCUT | 8
10 | | 377440 | BAIL 11" | 1
11 | | 390054 | 1952B MANUAL | 1
12 | | 343723 | LINE CORD | 1
(4PLS)
(2 PLS)
(2PLS)
(6PLS)
REMOVE BACKING PAPER
ITEM | REF DES | P/N | NOMENCLATURE | QTY
1 | | 372425 | FRONT PANEL METAL | 1
2 | | 408633 | FRONT PANEL DECAL | 1
3 | | 408625 | LENS | 1
4 | | 390567 | HEAT SINK | 1
5 | | | 1952B-8013 BRACKET | 2
6 | | 178127 | BNC JACK | 2
7 | | 167015 | GROUND LUG 3/8" | 2
8 | | 375469 | SCREW #4-40 x 1/4 FHP,CSK | 4

Final Assembly, Model 1952B



ITEM	REF DES	P/N#	NOMENCLATURE	QTY
1	C1, C2	188003	CAPACITOR .008uf 3000V	2
2	C8	168153	470uf 25V	1
3	C5	234008	2200uf 25V	1
4	C3, C4	379370	4700uf 10V	2
5	C86	192814	100uf 16V	1
6	C37	369181	220uf 16V	1
7		193623	10 uf 16V	14
8	CR3-CR6	236509	DIODE BRIDGE KBP02	
9	CR1, CR2	187716	IN4720	2
0		364224	IN914	12
11	CR7	153798	ZENER IN751A	1
12	CR13-CR16	369595	FHI100 OR HPA3082-2835	4
13		381806	IN3062	8
14	Q4	246462	TRANSISTOR 2N2905	1
5	Q2	150359	2N3053	1
16	Q6,Q9,Q3	369645	2N4274	3
17	Q18	369603	2N4257	1
18	Q17	386094	SX3819	1
19	Q20	369652	SX4061	1
20		369678	T1698	6
21	Q6,Q13	379271	E421	2
22	Q7-Q12	369629	2N5771	6
23		282553	I.C. 7400	5
24		283158	7450	8
25	U6	363457	74S11	1
26	U7, U8	363440	74S112	2
27	U9, U10	379289	74S64	2
28		363580	74S00	4
29	U12	310227	7474	1
30	U16	413617	74S04	1
31	U15	292595	7410	1
32	U22, U29	368571	7473	2
33	U28	283142	7442	
34	U27	320754	74136	
35	U17, U18	379420	7Z3	2
36	U24, U25	369702	10116	2
37	U36	375780	LM309H	
38				
39		36814C	CAPACITOR .001 uf	8

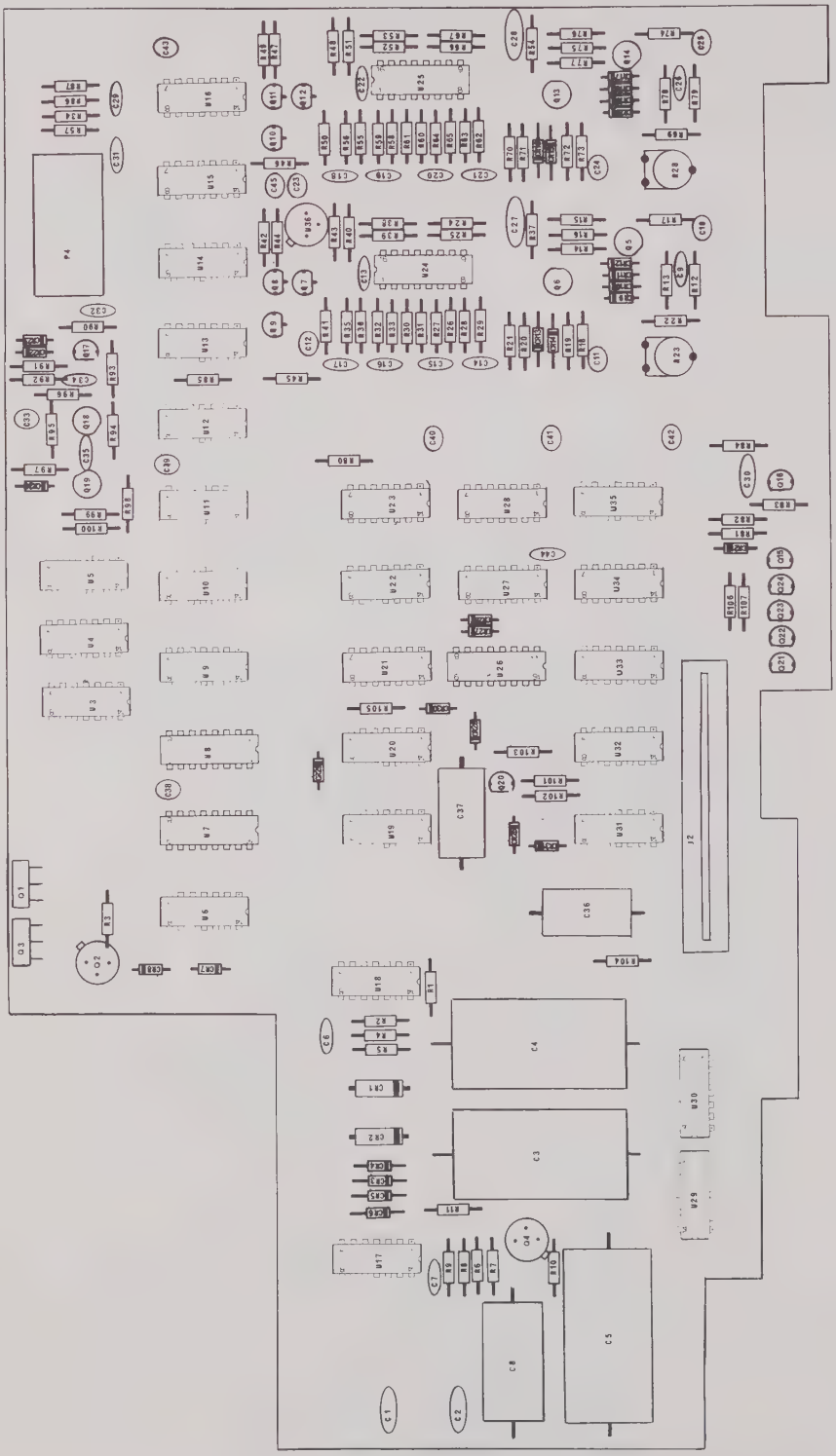
SEE SHT 1 OF 2

ITEM	REF DES	P/N#	NOMENCLATURE	QTY
40	C22, C36	365579	CAPACITOR .01uf 50V	
41	C4-C21	368157	22pf 500V	
42	C23,C30	368199	.1 uf 25V	
43	C9, C26	365132	47pf 500V	
44	R23, R68	369553	RESISTOR TRIMPOT 10K	
45	R35,R10	170720	1/4W, 5% CC 2K7	
46	R8	148038	6K8	
47	R6,R81 R86	148056	5K3	
48		147868	10	
49		148049	1K2	
50		190371	4K2	
51		148015	820	
52		148023	1K	
53	R39,R101	147975	330	
54	R82,R103	93441	80K	
55		147918	68	
56		148007	680	
57	R98	148114	5K	
58	R51,R54,R52	160804	270	
59		147959	220	
60		147983	470	
61		48031	15	
62	R37,R54	148130	62K	
63		147942	180	
64	R2,R79	148 89	30K	
65	R15, R76	148072	4K7	
66	R10, R74	175042	1M	
67	R22, R69	98350	2K2	
68		37450	19328-3001 MAIN PCB	
69	R81	182204	RESISTOR 1/4W, 5% CC 1M	
70	J2	369884	30 PIN EDGE CONN	
71	Q2,Q4,U8	152207	TRANSIS - PAD	
72	Q4	370155	HEAT SINK	
73	R88	147926	RES STOR 1/4W, 5% CC 100	
74		375840	GUIDE PINS	
75		376574	AMP PINS	

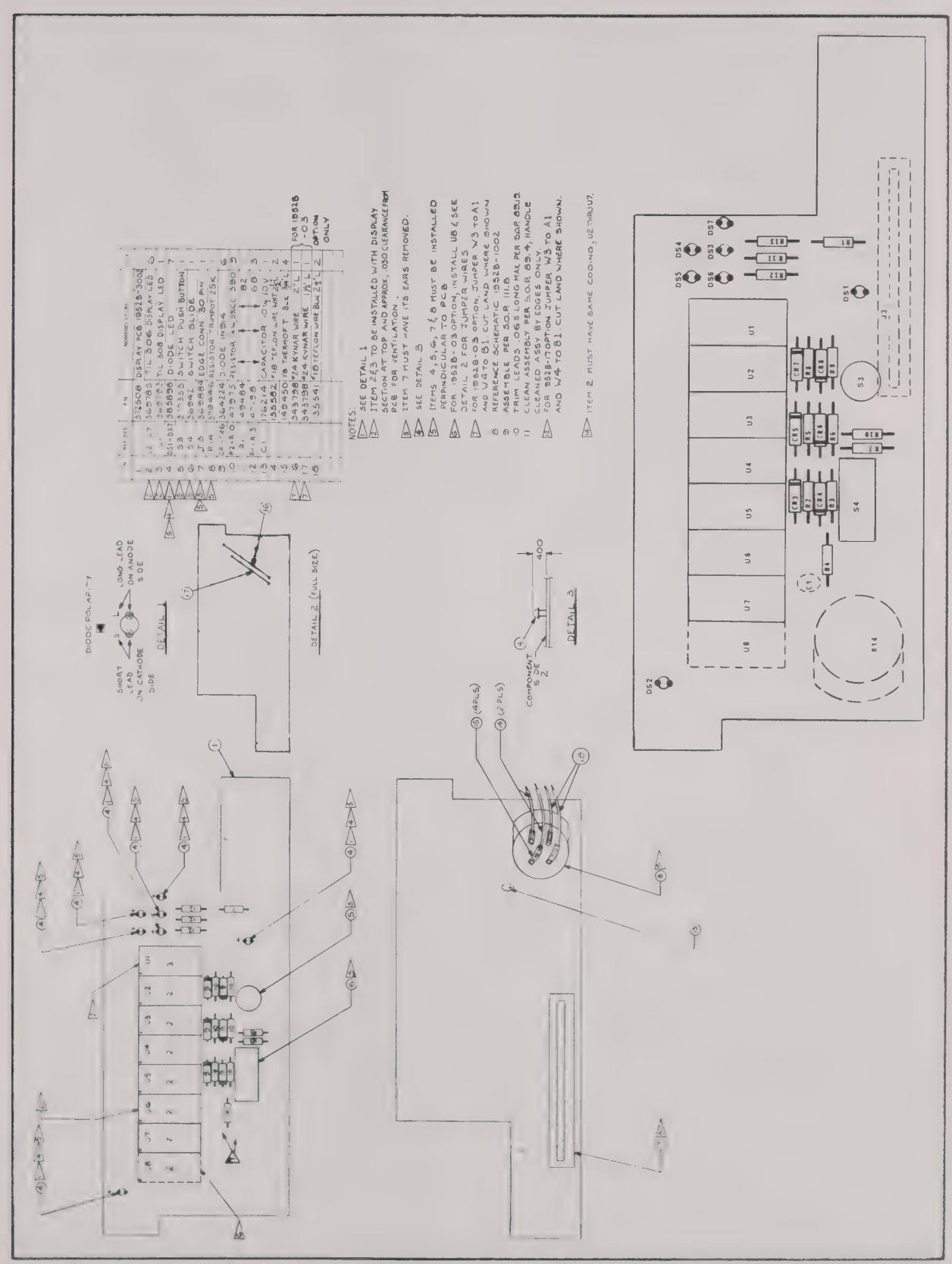
(75) (7 PLS)

NOTES:

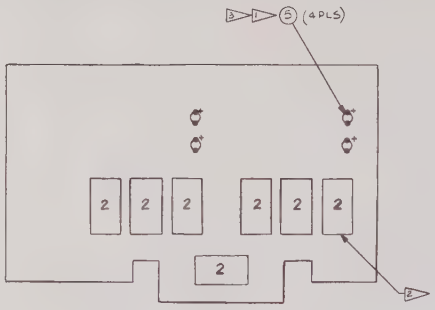
1. C10, C11, C12, C23, C24, C25, C33, C38, C39, C40, C41, C42, C43, C45
2. CR8, CR31, CR2, CR22, CR23, CR24, CR25, CR26, CR27, CR28, CR29, CR30
3. CR9, CR10, CR11, CR12, CR17, CR18, CR19, CR20
4. Q15, Q18, Q21, Q22, Q28, Q24
5. U13, U20, U21, U23, U30
6. U3, U4, U5, U31, U32, U33, U34, U35
7. U11, U14, U16, U28.
8. C6, C7, C29, C31, C32, C34, C35, C44
9. R2, R94, R96, R102, R11.
10. R5, R44, R47, R87
11. R4, R18, R20 R71, R73
12. R30, R31, R38, R39, R52, R53, R60 R61, R104
13. R1, R34, R40, R43, R48, R51, R57, R86, R87, R90, R106, R107.
14. R80, R83, R85, R100
15. R14, R77, R83, R105, R3,
16. R26, R29, R45, R46, R62, R63
17. R16, R19, R27, R28, R35, R36, R53, R56, R63, R64, R72, R75, R93
18. R24, R28, R32, R33, R50, R59, R66, R67
19. R13, R21, R42, R49, R70, R78

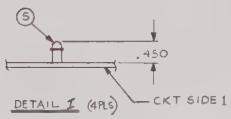


Main Board PC Assembly - Component Designation

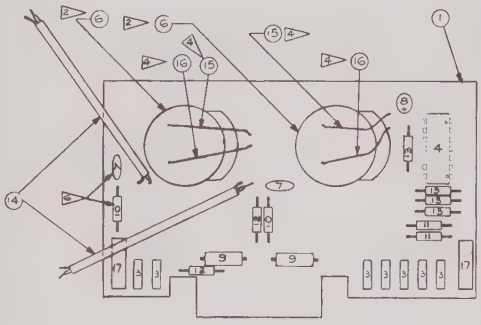


Display Board PC Assembly

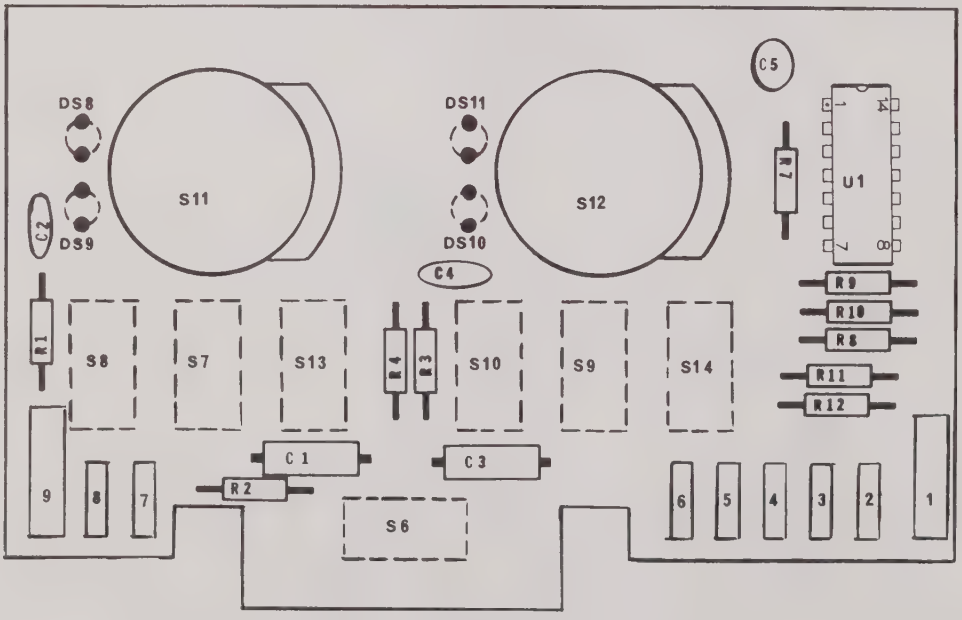




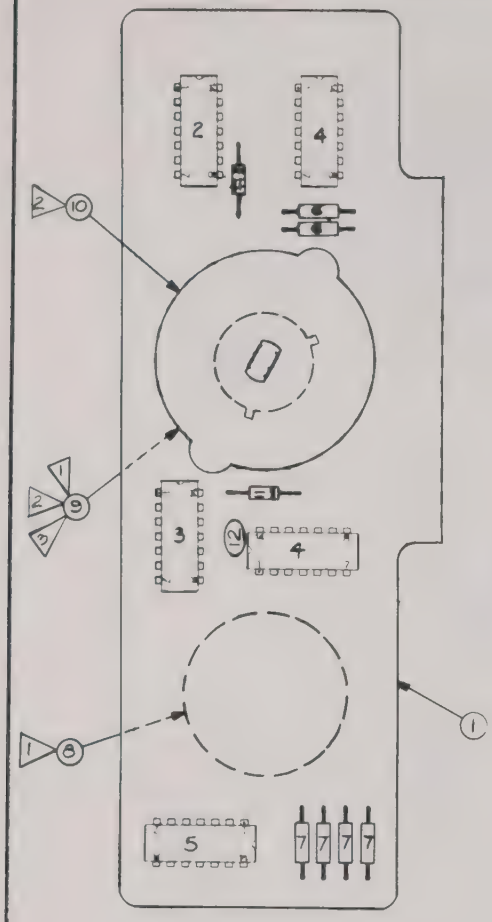
ITEM	REF DES	P/N	NOMENCLATURE	QTY
1		372524	INPUT PCB 1952B-3004	1
2	S	380113	SLIDE SWITCH	7
3	P1	375329	AMP PIN RECEPTACLE	7
4	U1	413617	I.C. 74S04	1
5	DS8-DS11	385898	DIODE LED	4
6	R5, R6	370247	TRIMPOT 10K	2
7	C2, C4	105908	CAPACITOR 1pf/250V	2
8	C5	193623	10µ/10V	1
9	C1, C3	161992	.1µ/250V	2
10	R1, R3	285338	RESISTOR 1/4W, 5% CC 910K	2
11	R11, R12	193441	180K	2
12	R2, R4	148189	100K	2
13	R7-R10	149484	82	4
14		190322	COAX CABLE 2 3/4" L.	2
15		115808	#22 TEFLON, VIOLET 2" L.	2
16		115766	#22 TEFLON, GRAY 2" L.	2
17	P1	149112	CONN TEST JACK	2



NOTES:
1. THE POSITIVE LEAD OF ITEM 5 IS THE LONG LEAD.
2. ITEMS 2 & 6 MUST BE INSTALLED PERPINDICULAR TO PCB.
3. SEE DETAIL I
4. FINISHED LENGTH OF CABLE 2"
5. S6 S7, S8, S9, S10, S13 & S14
6. TRIM LEADS OF THESE COMPONENTS AS CLOSE TO PCB AS POSSIBLE.
7. SEE SHT 2 OF 2 FOR WIRE LIST



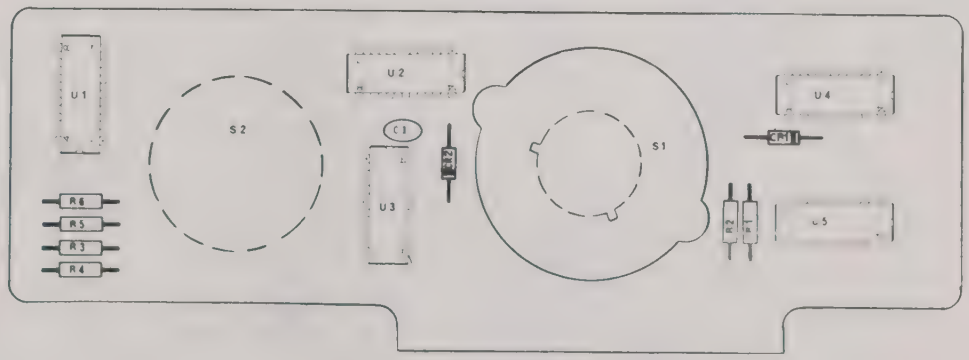
Input Board PC Assembly

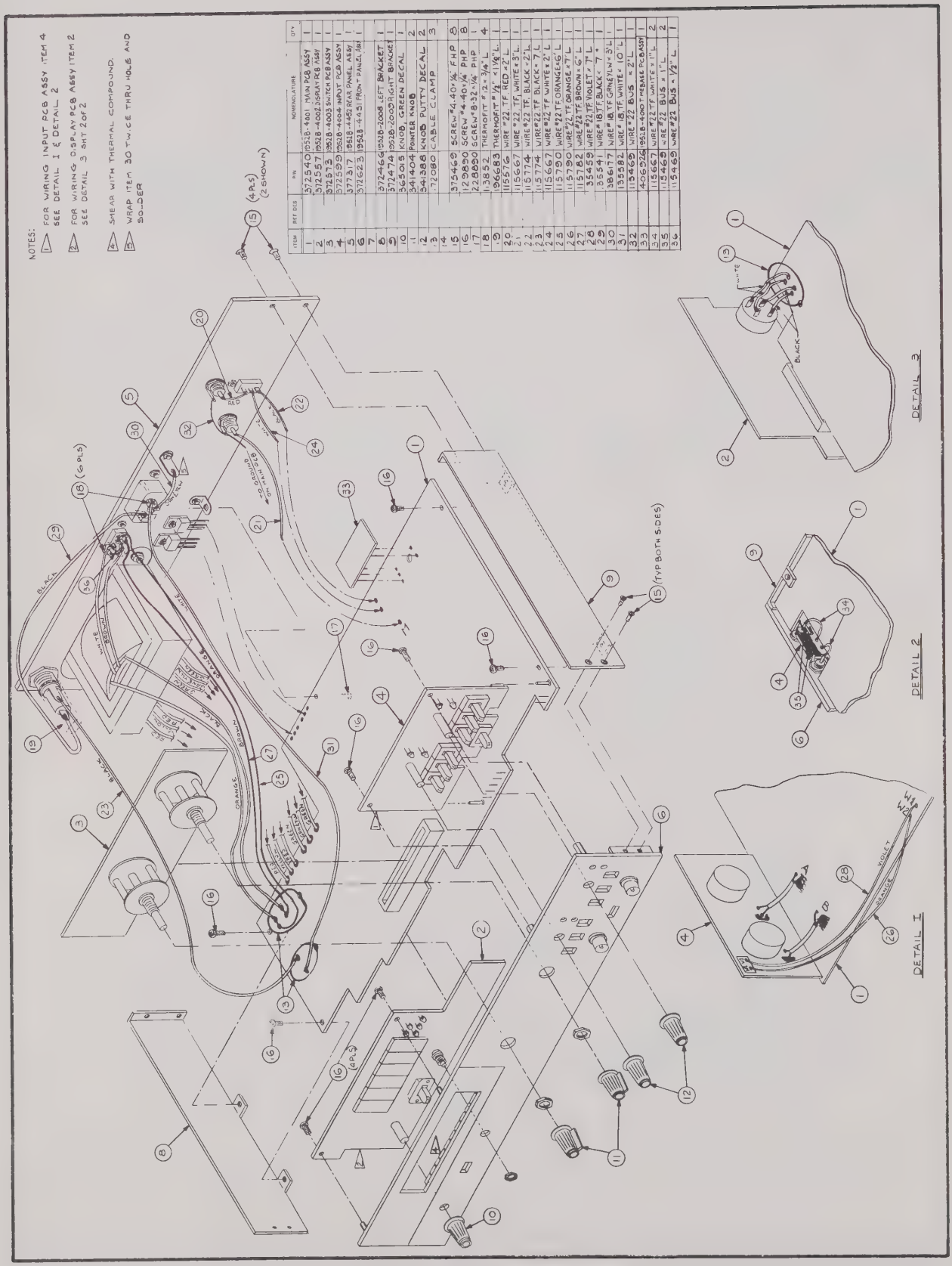


ITEM	REF DES	P/N	NOMENCLATURE	QTY
1		372516	1952B-3003 SWITCH PCB	1
2	U4	292953	I.C. 7400	1
3	U2	292979	7404	1
4	U3,U5	292995	7410	2
5	U1	293019	7430	1
6	R1,R2	147959	RESISTOR, 1/4W, 5% CC. 220	2
7	R3-R6	148023	RESISTOR, 1/4W, 5% CC. 1K	4
8	S2	412957	FUNCTION SWITCH	1
9	S1	413567	RANGE SWITCH	1
10	S1	413872	SWITCH WAFER	1
11	CR1,CR2	364224	DIODE IN914	2
12	C1	193623	CAPACITOR 10uf 16V	1

NOTES:

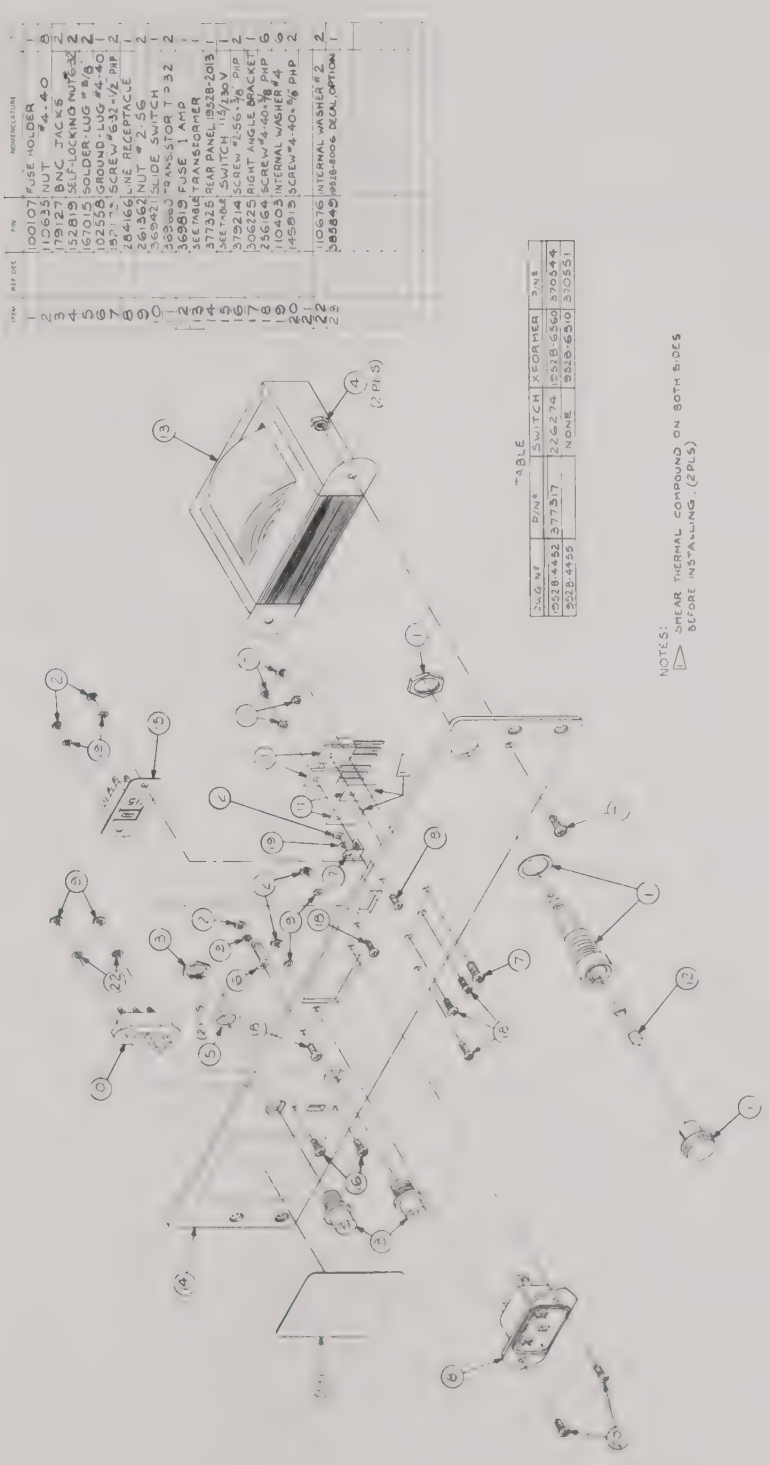
1. INSTALL ITEMS 8 & 9 ON CKT 1 SIDE.
2. ROTAR OF ITEM 10 MUST BE CLOCKED CORRECTLY WITH SHAFT OF ITEM 9
3. ITEM 9 IS SHOWN AT ITS CCW EXTREME POSITION WHEN VIEWED FROM CKT 1 SIDE.
4. REFERENCE SCHEMATIC 1952B-1003




NOTES:
1. FOR WIRING INPUT PCB ASSY ITEM 4 SEE DETAIL 1 & DETAIL 2
2. FOR WIRING DISPLAY PCB ASSY ITEM 2 SEE DETAIL 3 SHT 2 OF 2
4. SHEAR WITH THERMAL COMPOUND
5. WRAP ITEM 30 TWICE THRU HOLE AND SOLDER
DETAIL 1
DETAIL 2
DETAIL 3

ITEM	REF DES	P/N	NOMENCLATURE	QTY
1		372540	9518-4001 MAIN PCB ASSY	1
2		372557	9528-4002 DISPLAY PCB ASSY	1
3		372573	9518-4003 SWITCH PCB ASSY	1
4		372589	9518-4004 INPUT PCB ASSY	1
5		377317	9518-4452 REAR PANEL ASSY	1
6		372623	9518-4451 FRONT PANEL ASSY	1
7				
8		372464	9518-2008 LEFT BRACKET	1
9		372474	9518-2009 RIGHT BRACKET	1
10		365015	KNOB, GREEN DECAL	1
11		341404	POINTER KNOB	2
12		341388	KNOB PUTTY DECAL	2
13		72080	CABLE CLAMP	3
14				
15		375469	SCREW 4-40 X 1/4 FHP	8
16		129830	SCREW 4-40 X 1/4 PHP	8
17		228850	SCREW 6-32 X 1/4 PHP	1
18		13852	THERMOFIT 1/4 X 3/4 L	4
19		96683	THERMOFIT 1/4 X 1 1/2 L	1
20		115576	WIRE #22 TF RED - 2 L	1
21		115667	WIRE #22 TF WHITE - 3 L	1
22		115774	WIRE #22 TF BLACK - 2 L	1
23		115774	WIRE #22 TF BLACK - 7 L	1
24		115667	WIRE #22 TF WHITE - 2 L	1
25		115790	WIRE #22 TF ORANGE - 6 L	1
26		115790	WIRE #22 TF ORANGE - 7 L	1
27		115782	WIRE #22 TF BROWN - 6 L	1
28		35549	WIRE #22 TF VIOLET - 7 L	1
29		135541	WIRE #18 TF BLACK - 3 L	1
30		38677	WIRE #18 TF GREY - 40 L	1
31		135582	WIRE #22 TF WHITE - 10 L	1
32		113665	WIRE #22 BUS - 2 L	1
33		406926	9518-4001-MBARE PCB ASSY	1
34		115667	WIRE #22 TF WHITE - 1 L	2
35		113469	WIRE #22 BUS - 1 L	1
36		115469	WIRE #22 BUS - 1/2 L	1

Front Panel Assembly



ITEM	REF DES	P/N	NOMENCLATURE	
1		100107	FUSE HOLDER	1
2		110635	NUT #4-40	8
3		79127	BNC JACKS	2
4		52819	SELF-LOCKING NUT 6-32	2
5		167015	SOLDER-LUG #8/0	2
6		102558	GROUND-LUG #4-40	1
7		19178	SCREW #6-32 x 1/2 PHP	2
8		284166	LINE RECEPTACLE	1
9		261362	NUT #2-56	2
10		36942	SLIDE SWITCH	1
11		369900	TRANSISTOR T-32	2
12		369819	FUSE 1 AMP	1
13		377326	REAR PANEL 9528-2013	1
14		SEE TABLE	TRANSFORMER	1
15		SEE TABLE	SWITCH 115/230 V	1
16		379214	SCREW #2-56 x 3/8 PHP	2
17		306225	RIGHT ANGLE BRACKET	1
18		256164	SCREW #4-40 x 7/8 PHP	6
19		110403	INTERNAL WASHER #4	6
20		145815	SCREW #4-40 x 5/8 PHP	2
21				
22		110676	INTERNAL WASHER #2	2
23		388849	9528-6006 DECAL, OPTION	1

TABLE

DWG Nº	P/Nº	SWITCH	XFORMER	DNS
9528-4452	377317	2262274	9528-6560	370544
9528-4455		NONE	9528-6510	370551

Section 6

Option & Accessory Information

6-1 INTRODUCTION

6-2 This section of the manual contains information pertaining to the accessories and -03 option available for your instrument.

6-3 ACCESSORY INFORMATION

6-4 1952B rack adapter M00-200-614. Printer Interface Kit 2010A - 7011.

6-5 OPTION INFORMATION

6-6 The -03 option provides a 8 digit LED display and includes a Temperature Compensated Crystal Oscillator (TCXO) which has timebase stability and temperature dependent characteristics which are superior to the oscillator normally installed in the standard unit.

The TCXO specifications are as follows:

FREQUENCY	10.00 MHz
AGING RATE (per month)	$< \pm 3 \times 10^{-7}$
TEMPERATURE STABILITY 0 - 50°C 20 - 30°C	 $< \pm 2 \times 10^{-6}$ $\pm 5 \times 10^{-7}$ typ.
LINE VOLTAGE (± 10% CHANGE)	 $< \pm 1 \times 10^{-7}$

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable parts contained in Section 5. The following information is presented in this section:

List of Abbreviations

Federal Supply Codes for Manufacturers

Fluke Technical Service Centers — U.S. and Canada

Sales and Service Locations — International

Sales Representatives — U.S. and Canada

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
^{o}C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
^{o}F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^{9})
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^{3})
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^{6})
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(–) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmable read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisberg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884 - use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571 - use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
Ross Milton, Co., The
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Division
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, MA

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933 - use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept.
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988 - use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, MN

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

11711
General Instrument Corp
Rectifier Division
Hickville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Division
AMF Canada LTD.
Guelph, Onatrio, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
Budd Co. The, Polychem Products
Plastic Products Div.
Bridgeport, PA

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606 - use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors, formerly
Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
G T E Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Buckeye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co. Corporate H.Q.
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
A B Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
Mallory, P.R. & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp, formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, Californai

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey

70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnbach Radio Co., Inc.
Freeport, LI New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village, Chicago, Illinois

72005
Driver, Wilber B., Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303

72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrence, California

73445
Amperex Electronic Corp.
Hicksville, LI, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Company
Goshen, Indiana

79963
Zierick Mfg. Corp.
Mt. Kisko, New York

80031
Electro-Midland Corp., Mepco Div.
A North American Phillips Co.
Morristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183 - use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Stevens, Arnold Inc.
South Boston, Massachusetts

81073
Grayhill, Inc.
La Grange, Illinois

81312
Winchester Electronics
Div. of Litton Industries Inc.
Oakville, Connecticut

81439
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Mfg. Co.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Chicago, Illinois

82415
North American Phillips
Controls Corp.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Woodstock, New York

82879
ITT Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83058
Carr Co., The United Can Div.
of TRW
Cambridge, Massachusetts

83298
Bendix Corp.
Electric Power Division
Eatontown, New Jersey

83330
Smith, Herman H., Inc.
Brooklyn, New York

83478
Rubbercraft Corp. of America, Inc.
West Haven, Connecticut

83594
Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740
Union Carbide Corp.
Battery Products Div.
formerly Consumer Products Div.
New York, New York

84171
Arco Electronics
Great Neck, New York

84411
TRW Electronic Components
TRW Capacitors
Ogallala, Nebraska

84613
Fuse Indicator Corp.
Rockville, Maryland

84682
Essex International Inc.
Industrial Wire Div.
Peabody, Massachusetts

86577
Precision Metal Products,
of Malden Inc.
Stoneham, Massachusetts

86684
Radio Corp. of America
Electronic Components Div.
Harrison, New Jersey

86928
Seastrom Mfg. Co., Inc.
Glendale, California

87034
Illuminated Products Inc.
Subsidiary of Oak Industries Inc.
Anahiem, California

88219
Gould Inc.
Industrial Div.
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
Jewitt City, Connecticut

88690
Replaced by 04217

89536
Fluke, John Mfg. Co., Inc.
Seattle, Washington

89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

90201
Mallory Capacitor Co. Div of
P.R. Mallory Co., Inc.
Indianapolis, Indiana

90211 - use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
Tarrytown, New York

91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737 - use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
Santa Ana, California

91802
Industrial Devices, Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co., Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co., Inc.
Div of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154 - use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95712
Bendix Corp.
Electrical Components Div.
Microwave Devices Plant
Franklin, Indiana

95987
Weckesser Co. Inc.
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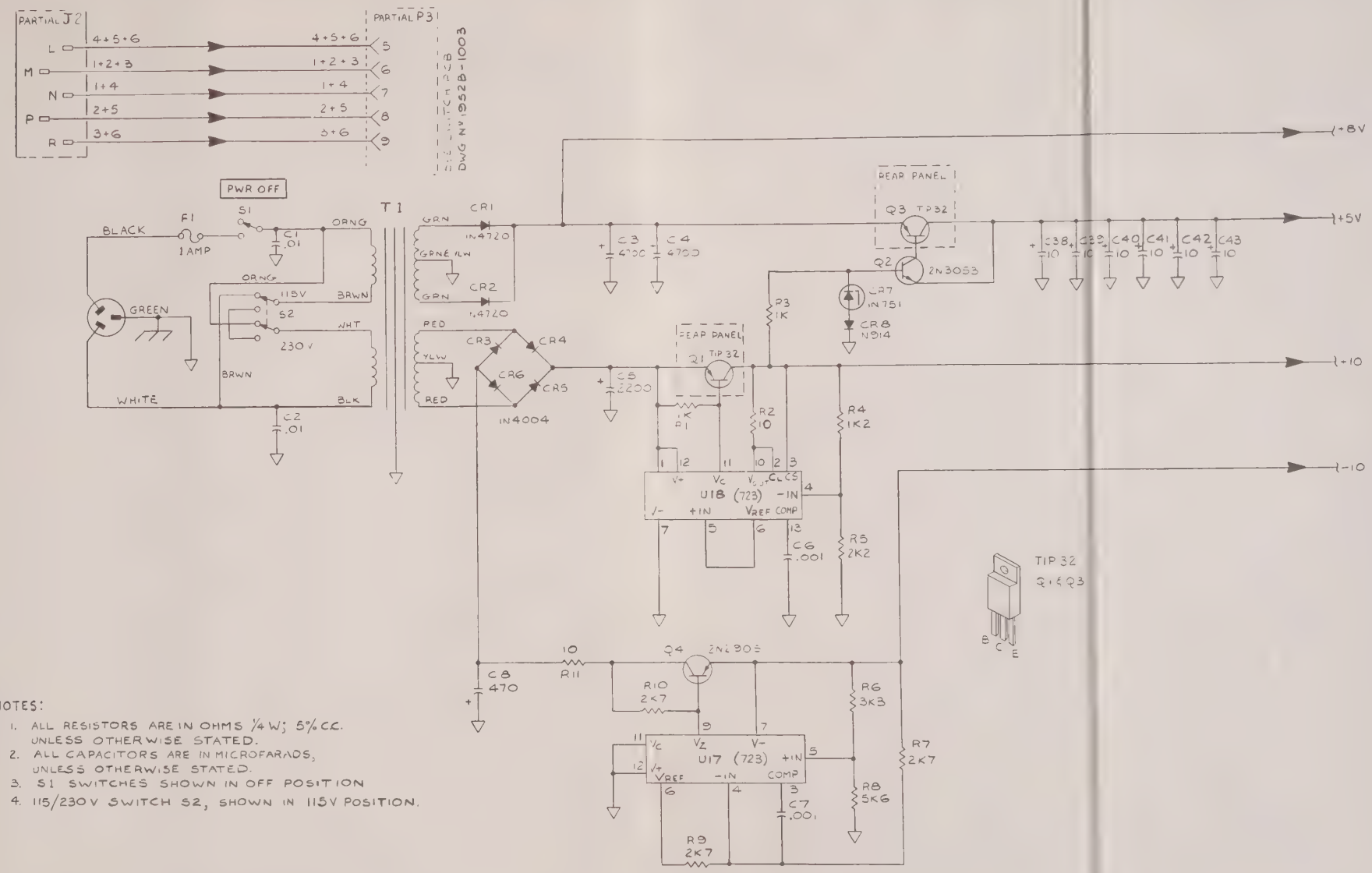
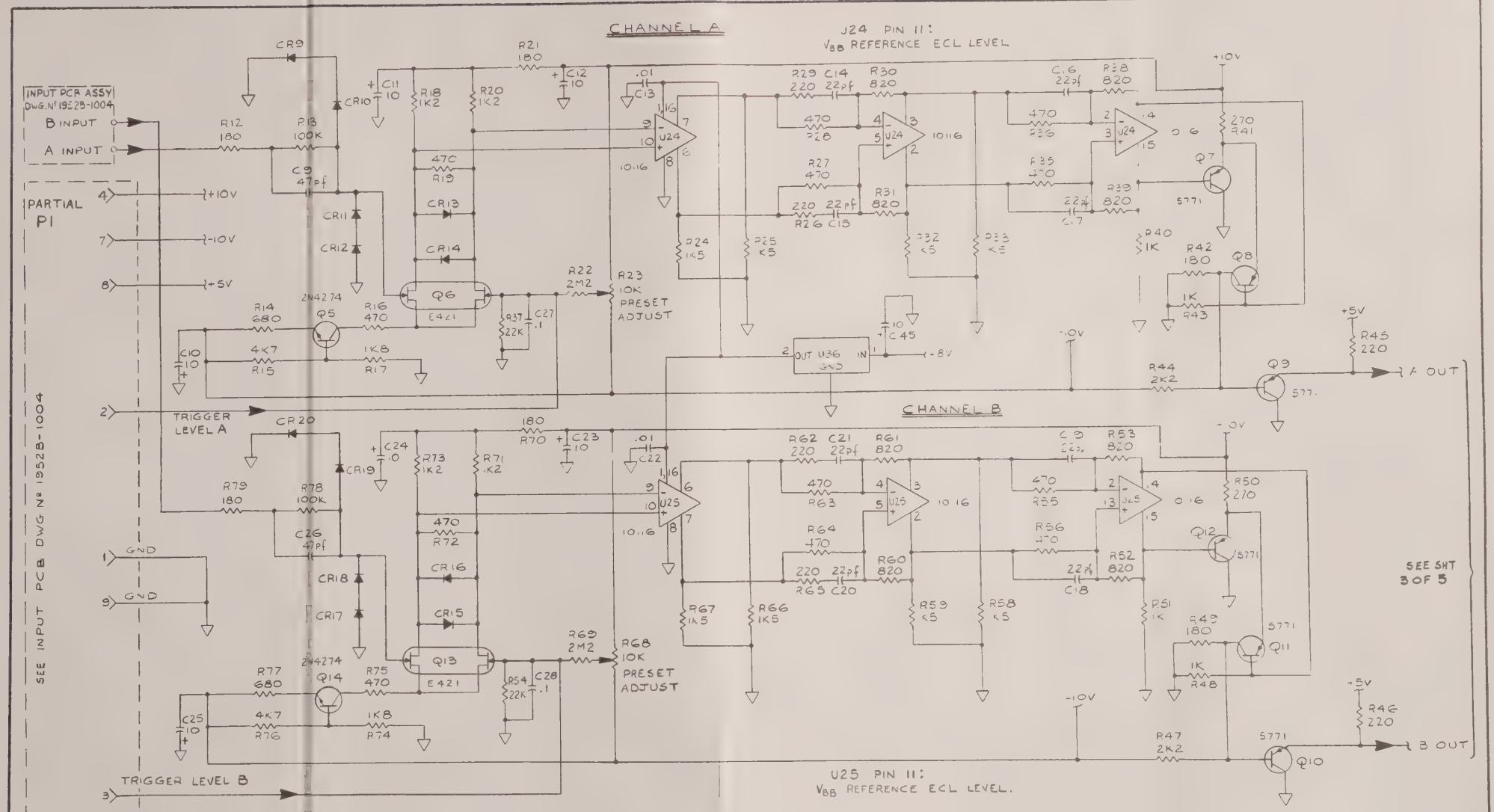


NOTES:

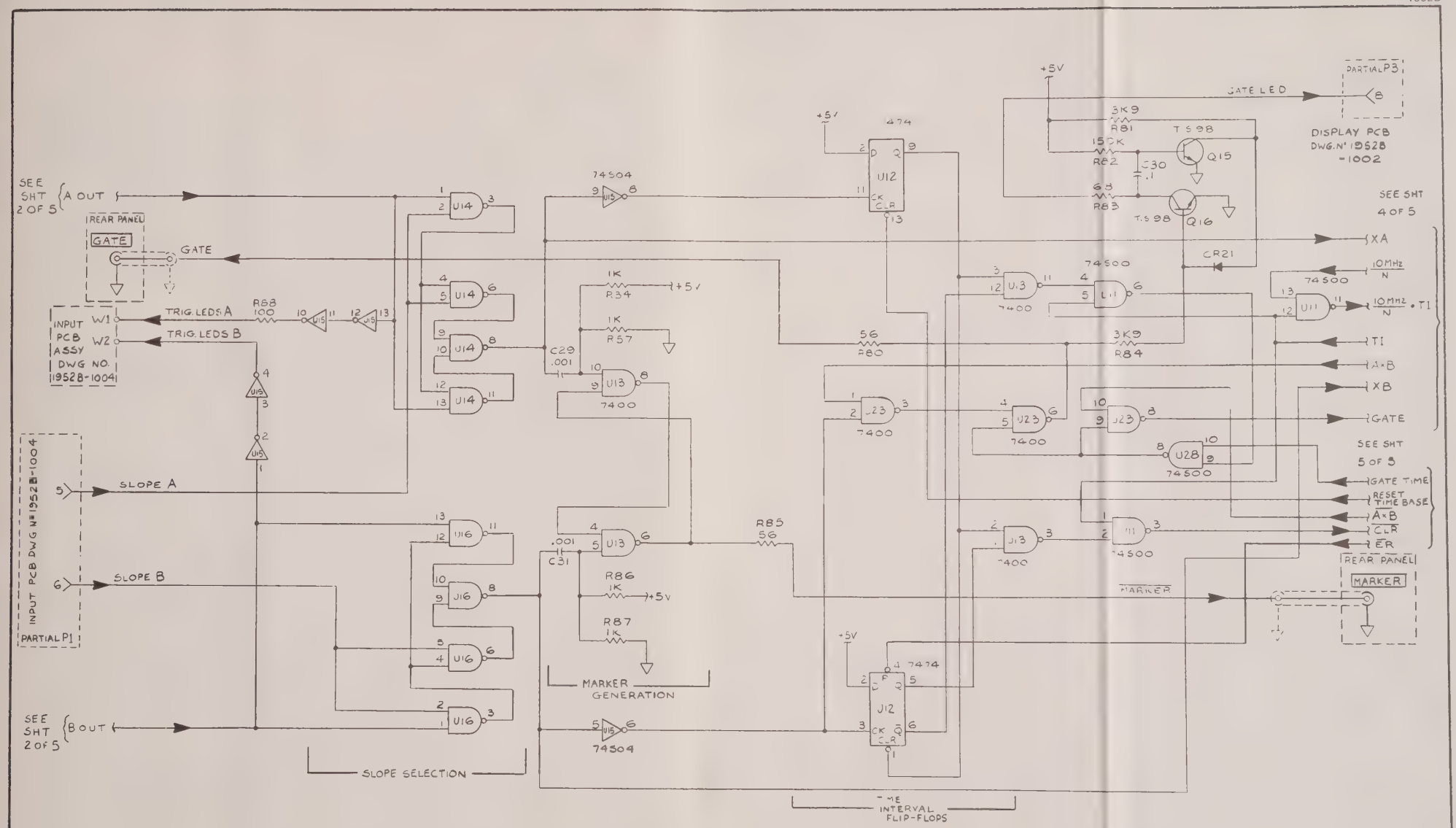
1. ALL RESISTORS ARE IN OHMS 1/4 W; 5% CC. UNLESS OTHERWISE STATED.
2. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE STATED.
3. S1 SWITCHES SHOWN IN OFF POSITION
4. 115/230V SWITCH S2, SHOWN IN 115V POSITION.

Main PCB Power Supply Schematic - 1952B-1001 - Sheet 1 of 5

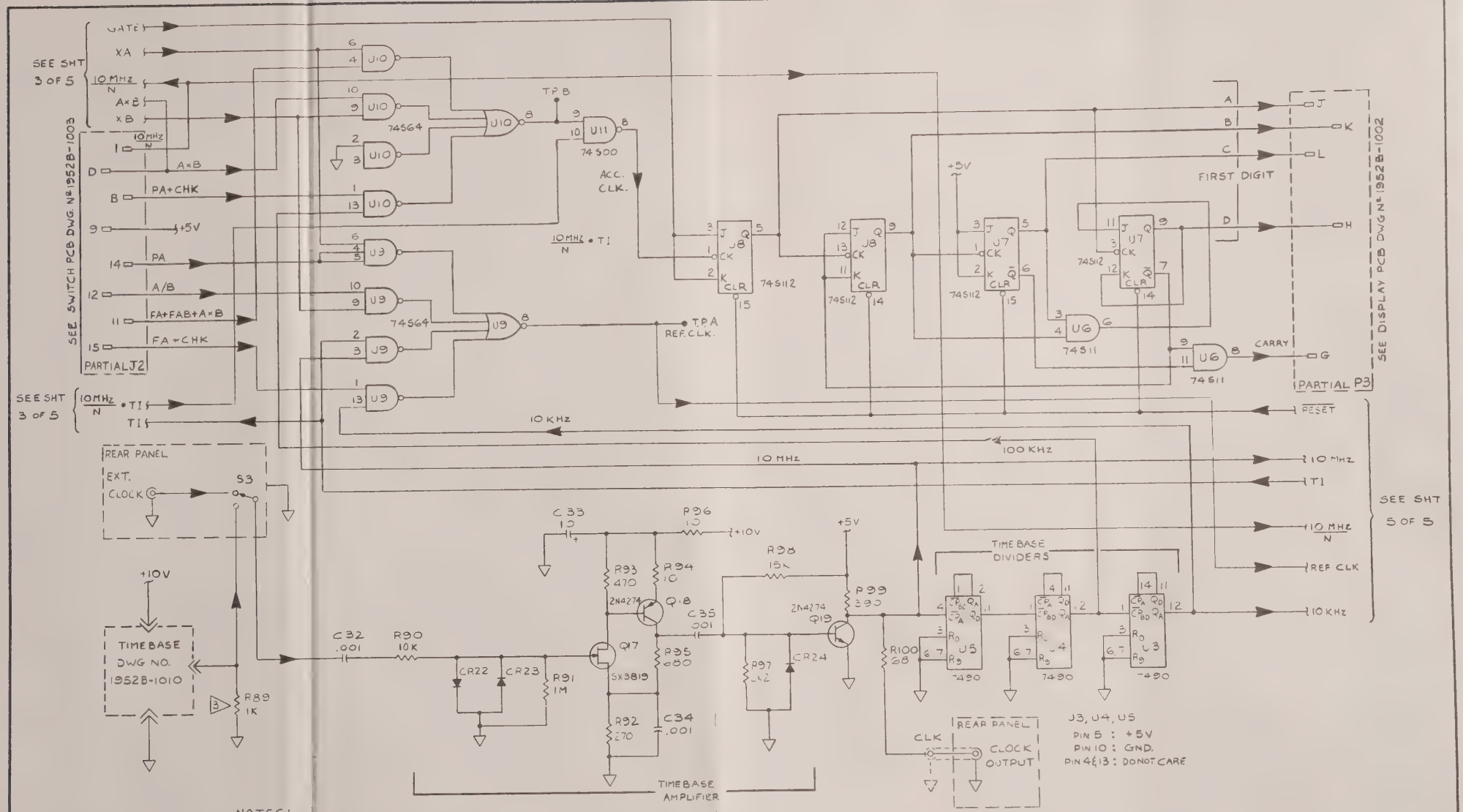


NOTES:
1. ALL RESISTORS ARE IN OHMS 1/4 W; 5% C.C. UNLESS OTHERWISE STATED.
2. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE STATED.

Main PCB Input Amplifier Schematic - 1952B-1001 - Sheet 2 of 5

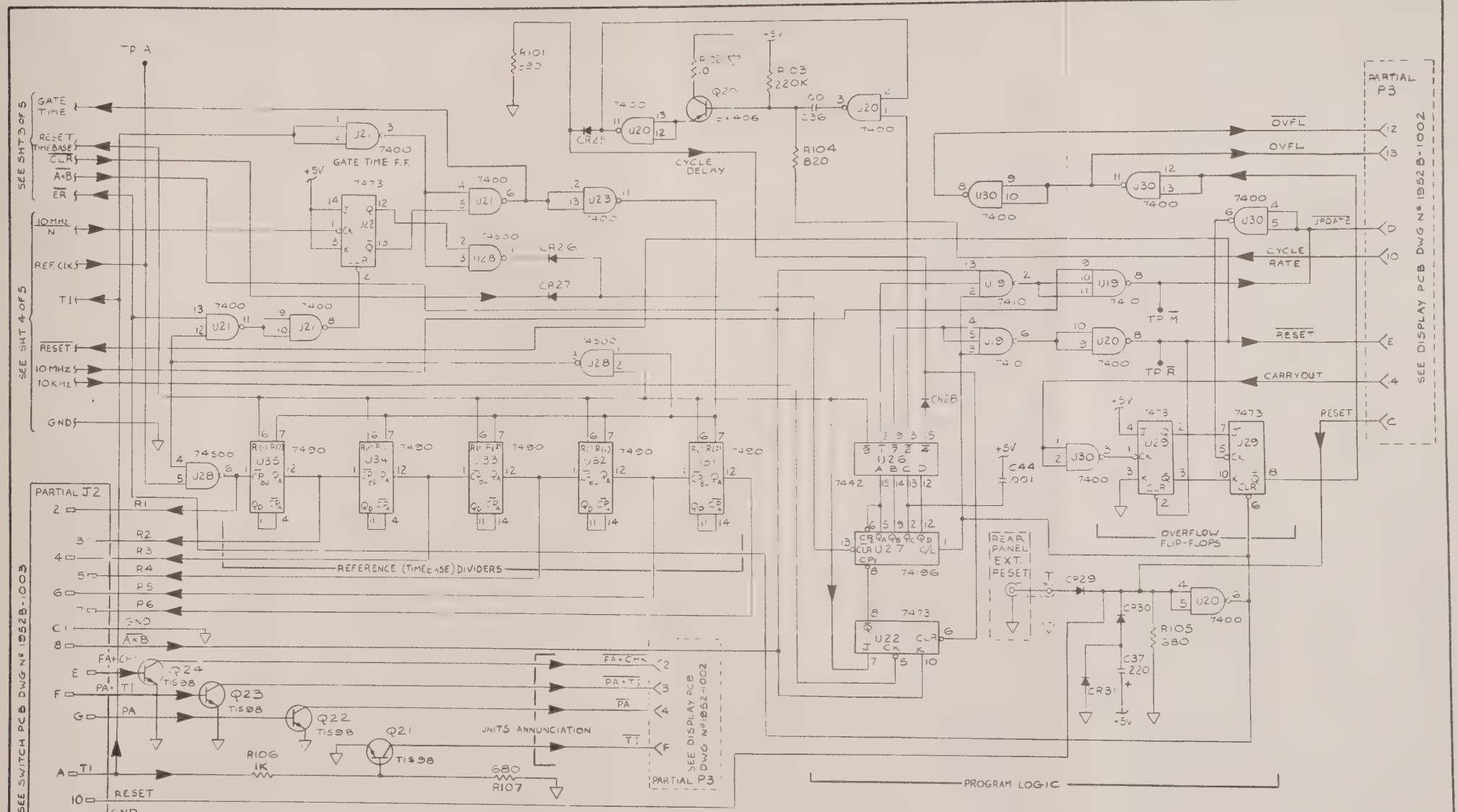


Main PCB Schematic - 1952B-1001 - Sheet 3 of 5



NOTES:
1. ALL RESISTORS ARE IN OHMS, 1/4 W; 5% C.C., UNLESS OTHERWISE STATED
2. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE STATED.
3. ADD 1K RESISTOR 1/4 W 5% C.C., TO REDUCE OUTPUT LEVEL OF TCXO (ONLY IF REQ'D)

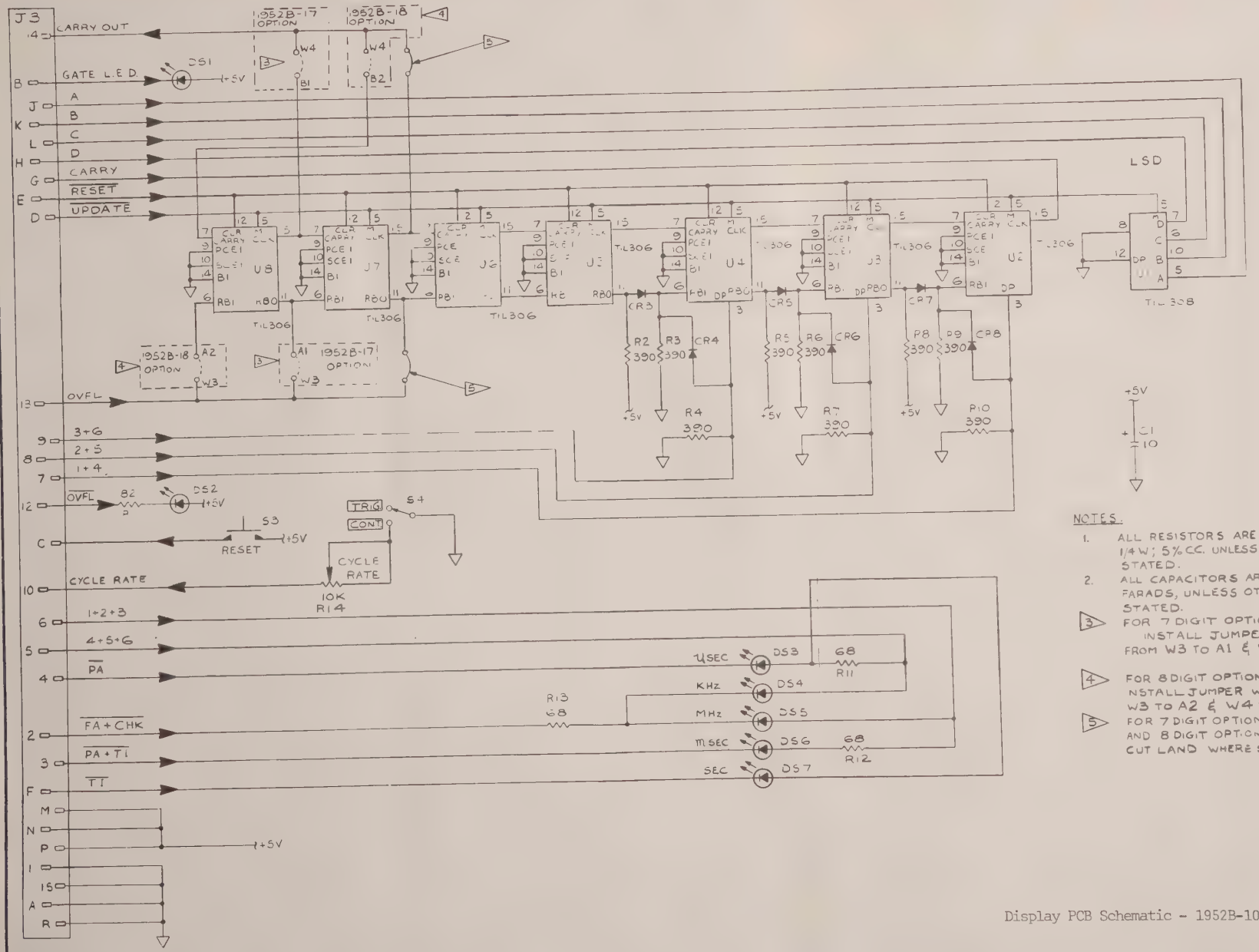
Main PCB Schematic - 1952B-1001 - Sheet 4 of 5



NOTES

1. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE STATED.
2. ALL RESISTORS ARE IN OHMS, 1/4 W; 5% C.C. UNLESS OTHERWISE STATED
3. U31, U32, U33, U34 & U35, PIN 5: +5V, PIN 10: GND, PINS 4 & 13: DO NOT CARE.

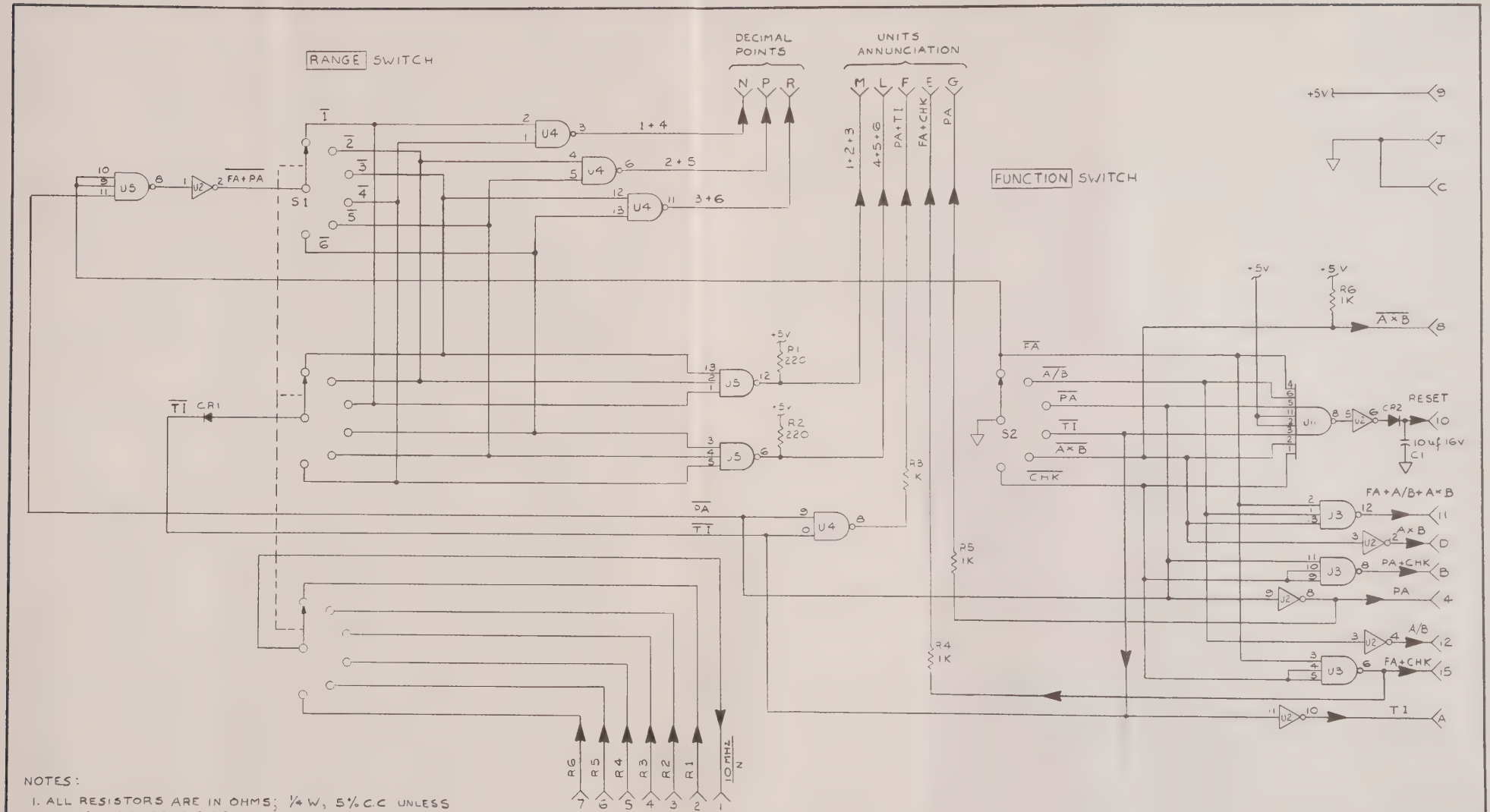
Main PCB Schematic - 1952B-1001 - Sheet 5 of 5



NOTES:

1. ALL RESISTORS ARE IN OHMS, 1/4 W; 5% CC. UNLESS OTHERWISE STATED.
2. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE STATED.
3. FOR 7 DIGIT OPTION INSTALL JUMPER WIRES FROM W3 TO A1 & W4 TO B1
4. FOR 8 DIGIT OPTION INSTALL JUMPER WIRES FROM W3 TO A2 & W4 TO B2.
5. FOR 7 DIGIT OPTION AND 8 DIGIT OPTION CUT LAND WHERE SHOWN. (2 PLS.)

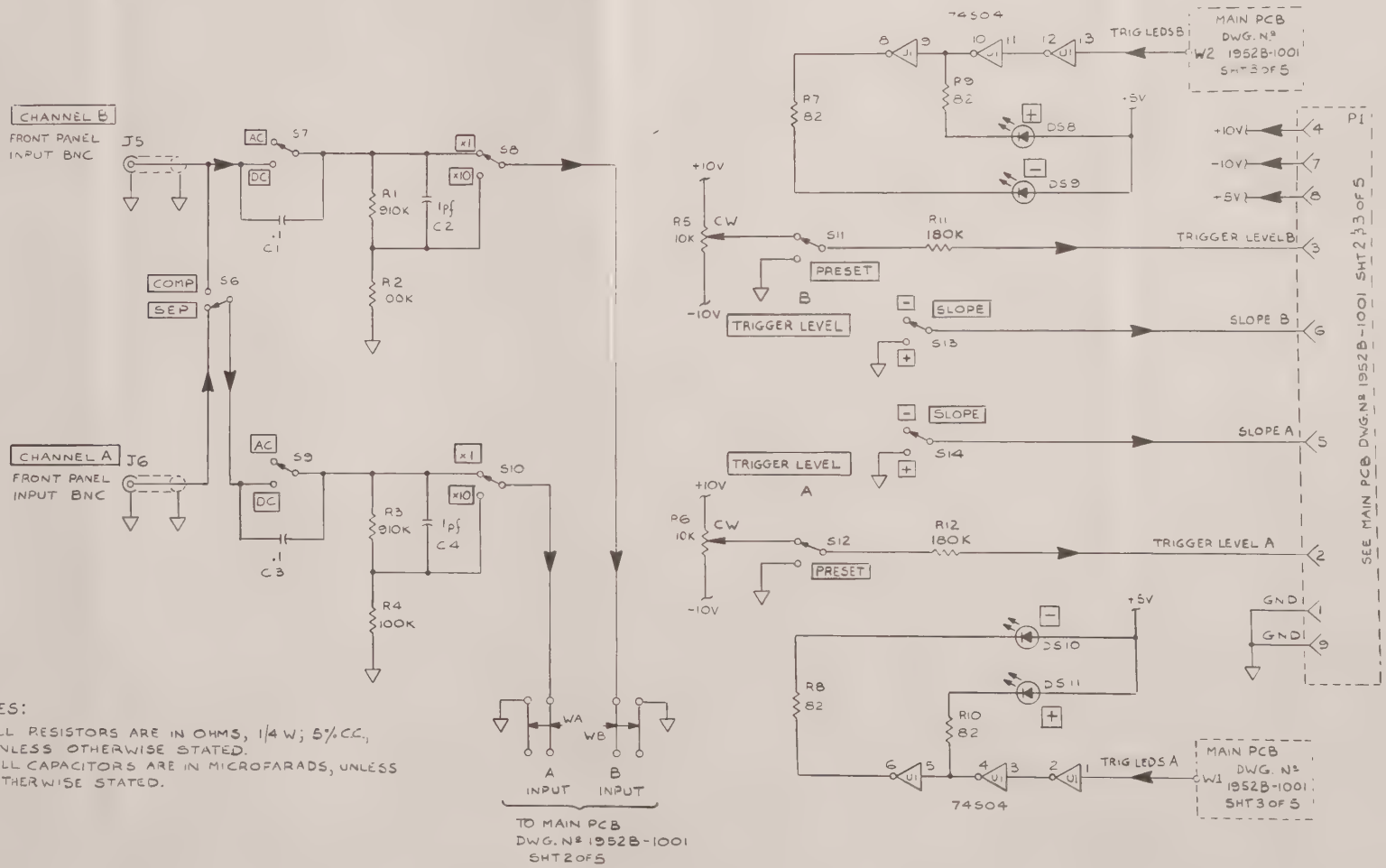
Display PCB Schematic - 1952B-1002 - Sheet 1 of 1



NOTES:

1. ALL RESISTORS ARE IN OHMS; ¼ W, 5% C.C UNLESS OTHERWISE SPECIFIED.

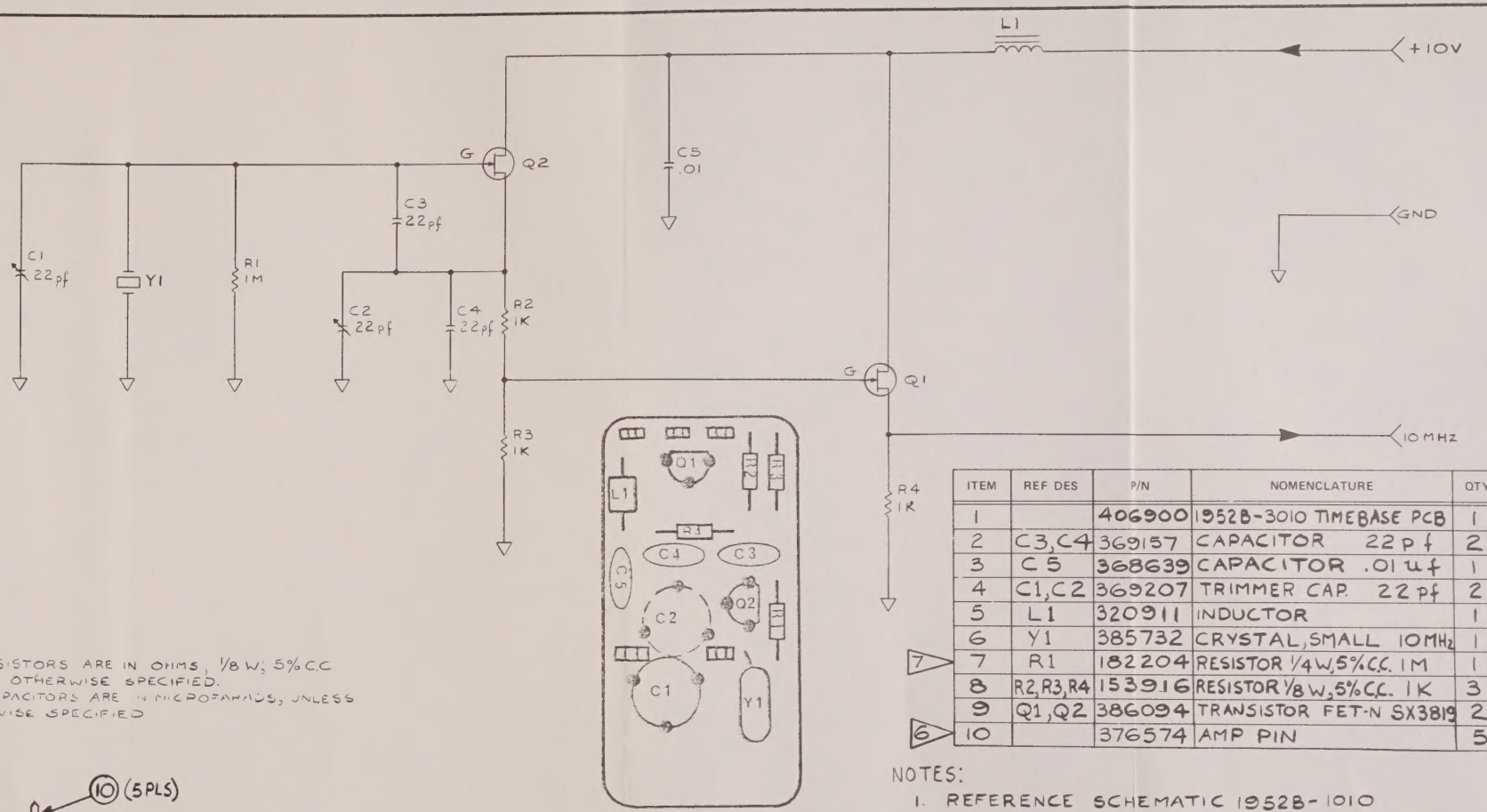
Switch PCB Schematic - 1952B-1003 - Sheet 1 of 1



NOTES:

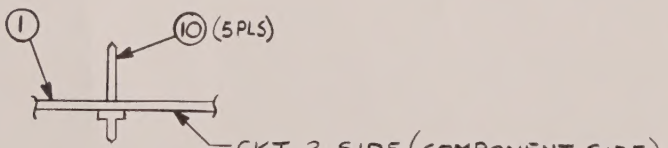
1. ALL RESISTORS ARE IN OHMS, 1/4 W; 5% CC., UNLESS OTHERWISE STATED.
2. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE STATED.

Input PCB Schematic - 1952B-1004 - Sheet 1 of 1



ITEM	REF DES	P/N	NOMENCLATURE	QTY
1		406900	1952B-3010 TIMEBASE PCB	1
2	C3,C4	369157	CAPACITOR 22 pf	2
3	C5	368639	CAPACITOR .01 uf	1
4	C1,C2	369207	TRIMMER CAP. 22 pf	2
5	L1	320911	INDUCTOR	1
6	Y1	385732	CRYSTAL, SMALL 10MHz	1
7	R1	182204	RESISTOR 1/4W, 5% CC. 1M	1
8	R2,R3,R4	153916	RESISTOR 1/8W, 5% CC. 1K	3
9	Q1,Q2	386094	TRANSISTOR FET-N SX3819	2
6	10	376574	AMP PIN	5

NOTES:
1. ALL RESISTORS ARE IN OHMS, 1/8 W; 5% C.C UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE SPECIFIED



DETAIL 1

NOTES:
1. REFERENCE SCHEMATIC 1952B-1010
2. ASSEMBLE PER S.O.P. 111.8
3. TRIM LEADS .065 MAX. LONG PER S.O.P 89.19
4. CLEAN ASSEMBLY PER S.O.P 89.4, HANDLE CLEANED ASSY BY EDGES ONLY.
5. INSTALL CKT 1 SIDE.
6. SEE DETAIL 1.
7. ITEM 7 PREP DIFFERENTLY, E.G.

Timebase PCB Schematic - 1952B-1010 - Sheet 1 of 1

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